# Iron AND Steel ENGINEER

ENGINEERING SERVICE
O THE IRON AND STEEL
NDUSTRY SINCE 1907

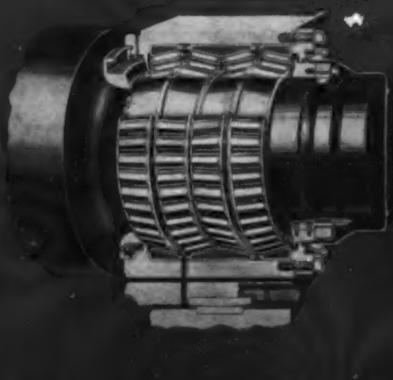
1010 EMPIRE BUILDING
MARCH, 1946
PITTSBURGH, PA.

NOLOGY DEPT.
MAR 30 1946
DETROIT

## roll neck roll call for 1945

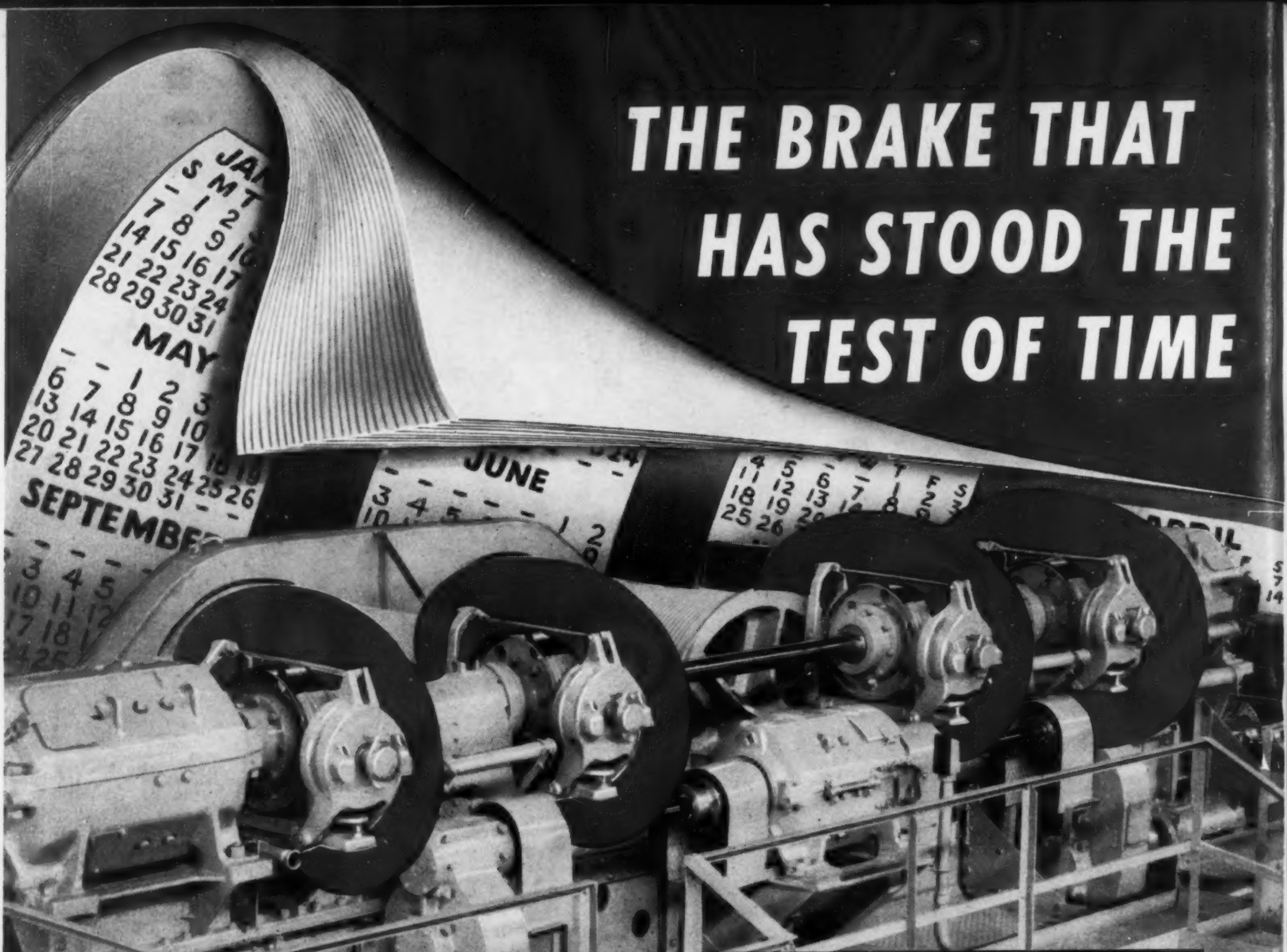
| MILL TYPE | MILL SIZE | NO. STANDS | BACK-UP ROLLS | WORK ROLLS |
|---|---|---|---|---|
| 2-high tube mill | 28 | 7 | | 10½x17½x7¾ |
| 2-high cold | 9x6 | 3 | | 5x7-3/16x6½ |
| 2-high cold | 18x18 | 1 | | 11-13/16x16⅝x12½ |
| 2-high cold | 28x56 | 1 | | 19⅝x28x14½ |
| 2-high cold | 8x10 | 1 | | 5x7-3/16x6½ |
| 2-high hot | 11 to 15 | 9 | | 6x10x4⅞ |
| 2-high cold | 20x66 | 1 | | 19⅝x24x14½ |
| 2-high cold | 9x9 | 1 | | 5x7-3/16x6¼ |
| 3-high cold | 6⅝x13½x22 | 1 | Plain | 5-5/16x5⅝x5 |
| 3-high hot | 20x54 | 1 | 11⅞x10x11⅞—all rolls | |
| 3-high hot | 20x60 | 1 | 11⅞x10x11⅞—all rolls | |
| 3-high cold | 8x14x42 | 2 | Plain | 5⅝x4½x4½ |
| 4-high cold | 10½x23¼x60 | 1 | 18⅝x21½x18⅝ | 6½x8⅞x6⅝ |
| 4-high cold | 9 and 21x34 | 2 | 13⅝x19⅝x13⅝ | 8½x7⅜x7½ |
| 4-high cold | 9 and 21x34 | 2 | | 8½x7⅜x7½ |
| 4-high cold | 9 and 21x34 | 7 | 13⅝x19⅝x13⅝ | 6⅝x8⅝x6⅝ |
| 4-high cold | 9 and 18x36 | 1 | | 5x7-3/16x6½ |
| 4-high cold | 20 and 49x54 | 5 | | 11x15½x10⅝<br>Thrust Bearings |
| 4-high cold | 6x18x18 | 1 | 11-13/16x16⅝x12½ | 3.5x5⅞x3 |
| 4-high cold | 6½x16x12 | 1 | 10x14½x10⅝ | 3-5/16x3½x3-3/16 |
| 4-high cold | 12½x27x32 | 1 | | 7x9⅝x7-9/16 |
| 4-high cold | 8½x27x32 | 1 | | 5x7-3/16x6½ |
| 4-high cold | 7x18x32 | 1 | 11½x16⅝x10⅝ | 3⅝x6⅝x5 |
| 4-high cold | 12x32¾x48 | 1 | 20-9/16x27x21⅛ | 9½x11½x8⅝ |
| 4-high cold | 20 and 49x56 | 5 | | 11x15½x10⅝<br>Thrust Bearings |
| 4-high cold | 2½ and 5½x17<br>and 18½x20 | 1 | 11-13/16x16⅝x12½<br>10⅝x15x11⅛ | |
| 4-high cold | 11x36x28 | 1 | [illegible] | 6½x8⅞x6⅝ |
| 4-high cold | 6½x20x20 | 1 | 11-13/16x16⅝x12½ | 3.31x5⅝x3 |
| 4-high cold | 11x29x30 | 1 | 16x23¼x16¾ | 8⅝x7⅝x8⅝ |
| 4-high hot | 16½x38x48 | 2 | | 9½x13⅝x9 |
| 4-high hot | 18x38x48 | 1 | | 10⅝x15½x10⅝ |
| 4-high cold | 14x30x30 | 2 | | 9½x13⅝x9 |
| 4-high cold | 3¼x9x8 | 4 | 4½x3⅝x4 | Plain |
| 4-high cold | 21x53x54 | 5 | | 13½x18x10 |
| 4-high cold | 10¼x23x32 | 1 | | 6½x8⅞x6⅝ |
| 4-high cold | 21¼x53x55 | 5 | | 13½x18x10 |
| 4-high cold | 18x49x42 | 2 | | 10⅝x15½x10⅝ |
| 4-high cold | 21 and 49x60 | 1 | | 13½x18x10 |
| 4-high cold | 10½x23¼x60 | 1 | 18⅝x21½x18⅝ | 6½x8⅞x6⅝ |
| 4-high cold | 10½x23¼x60 | 1 | | 6½x8⅞x6⅝ |
| 4-high cold | 10¼x28x32 | 1 | | 6½x8⅞x6⅝ |
| 4-high cold | 20 and 49x56 | 5 | | Thrust Bearings |

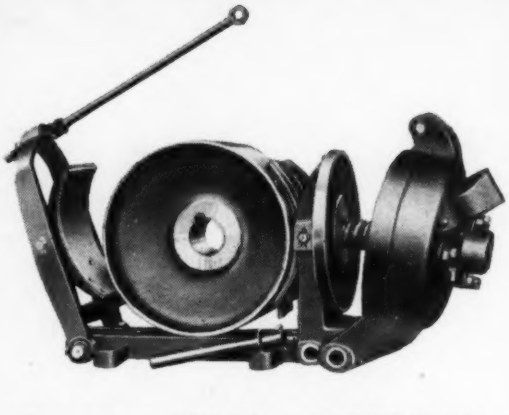
Here is a list of new rolling mills installed from January 1 to December 1, 1945 with Timken Roll Neck Bearings on back-up rolls, work rolls or both. It is proof of the continued popularity of and preference for Timken Roll Neck Bearings resulting from more than 20 years of engineering and metallurgical development. There is no substitute for experience. The Timken Roller Bearing Company, Canton 6, Ohio.



**TIMKEN**
TRADE-MARK REG. U. S. PAT. OFF.
ROLL NECK BEARINGS

# THE BRAKE THAT HAS STOOD THE TEST OF TIME





**Power transmitted in a straight line is power at its greatest efficiency**

Exploded view of C-H Type M Magnetic Brake shows simplicity of design, ruggedness of parts and directness of power application.

Cutler-Hammer engineers, long versed in mill requirements, designed the C-H Type M Brake with those specific needs in mind. With braking essentials concentrated into a few rugged parts, the C-H Type M Brake is simplicity itself; yet endowed with all the durability demanded by heavy duty operations. So dependable and efficient has been its performance that the C-H Type M Brake has never relinquished its preferred position anywhere. This matchless record is but another tribute to the engineering skill that has made the name Cutler-Hammer world-famous . . . another reason why discriminating users of electrical equipment today insist on Cutler-Hammer Brakes for each and every heavy duty installation. CUTLER-HAMMER, Inc., 1269 St. Paul Avenue, Milwaukee 1, Wisconsin. Associate: Canadian Cutler-Hammer, Ltd., Toronto, Ontario.

**CUTLER·HAMMER**
MOTOR CONTROL
C·H

AETNA·STANDARD

*Pace-setting Engineering*

HERE'S THE BLUEPRINT OF PACE-SETTING ENGINEERING

Aetna-Standard engineers for 42 years have been known the world over as designers of seamless tube mills and continuous buttweld pipe mills. In recent years, they have been internationally recognized for many other products, such as levellers, rolling mills, coating equipment, and sizing mills.

*Pace-Setting Engineering helps keep you in front.*

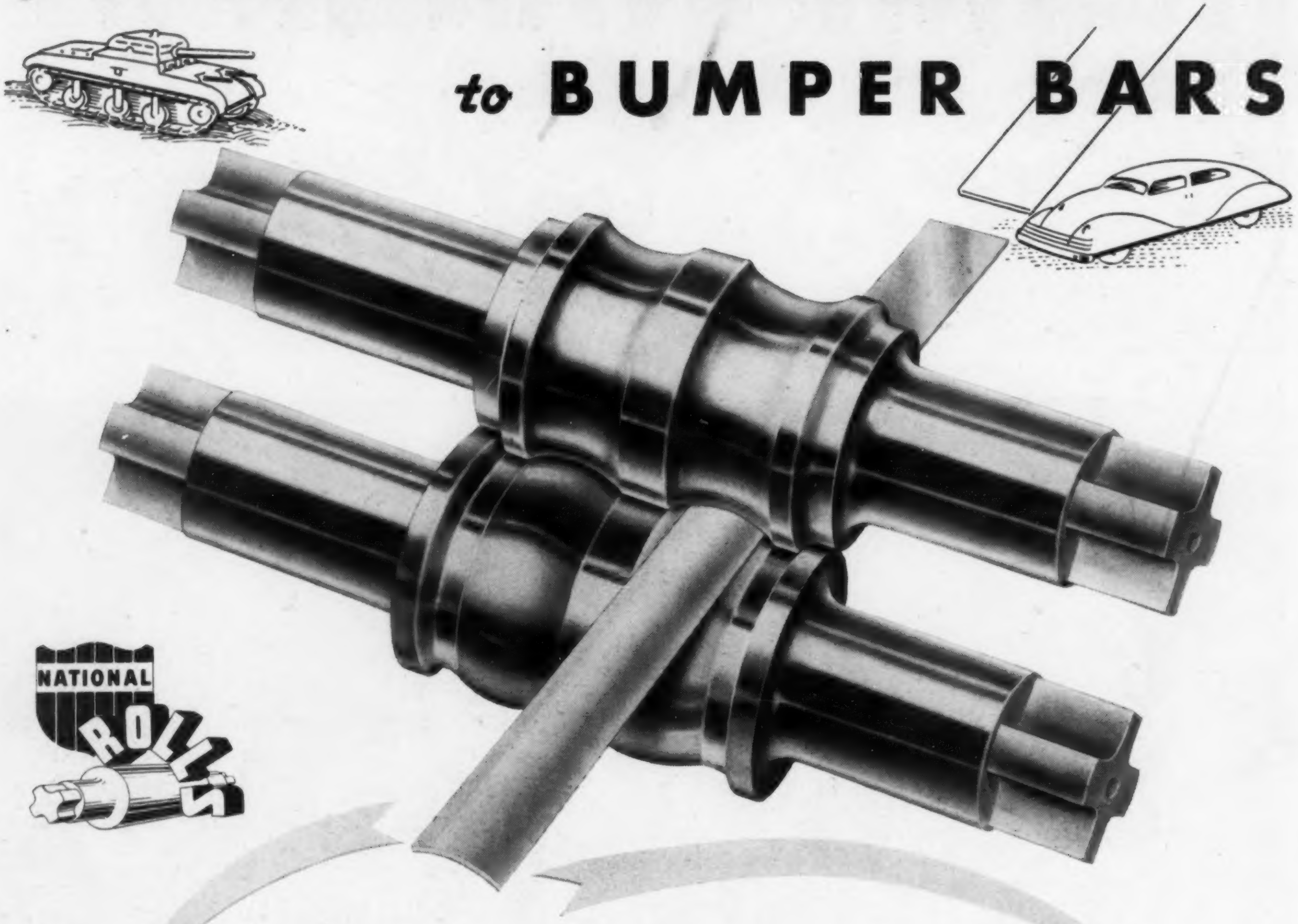
**THE AETNA-STANDARD ENGINEERING CO.**
**YOUNGSTOWN, OHIO**

*ASSOCIATED COMPANIES:*
HEAD, WRIGHTSON & COMPANY, LIMITED, THORNABY-ON-TEES, ENGLAND
JOHN INGLIS COMPANY, LIMITED, TORONTO, ONTARIO, CANADA

- World's foremost designers and builders of Seamless Tube Mills and Continuous Buttweld Pipe Mills.
- Pioneers in Coating Equipment, Continuous Galvanizing and Tinning.
- Originators of One-Man Drawbenches.
- New Products . . . recent examples:
  Rack-Type Drawbench
  Hydraulic Squeeze Pointer
  Automatic Tube Cut-Off
  Combination Plate Bending and Straightening Machine
  Bar Turning Pointer.

*From* **BATTLE BUGGIES**

*to* **BUMPER BARS**



From tank armor to bumper bars, National has successfully taken every metal forming challenge in stride.

New problems arise every day. Solutions based on new techniques are required. National through knowledge accumulated over the years has the acquired "know-how" to arrive at the right answer to any specific roll or casting problem.

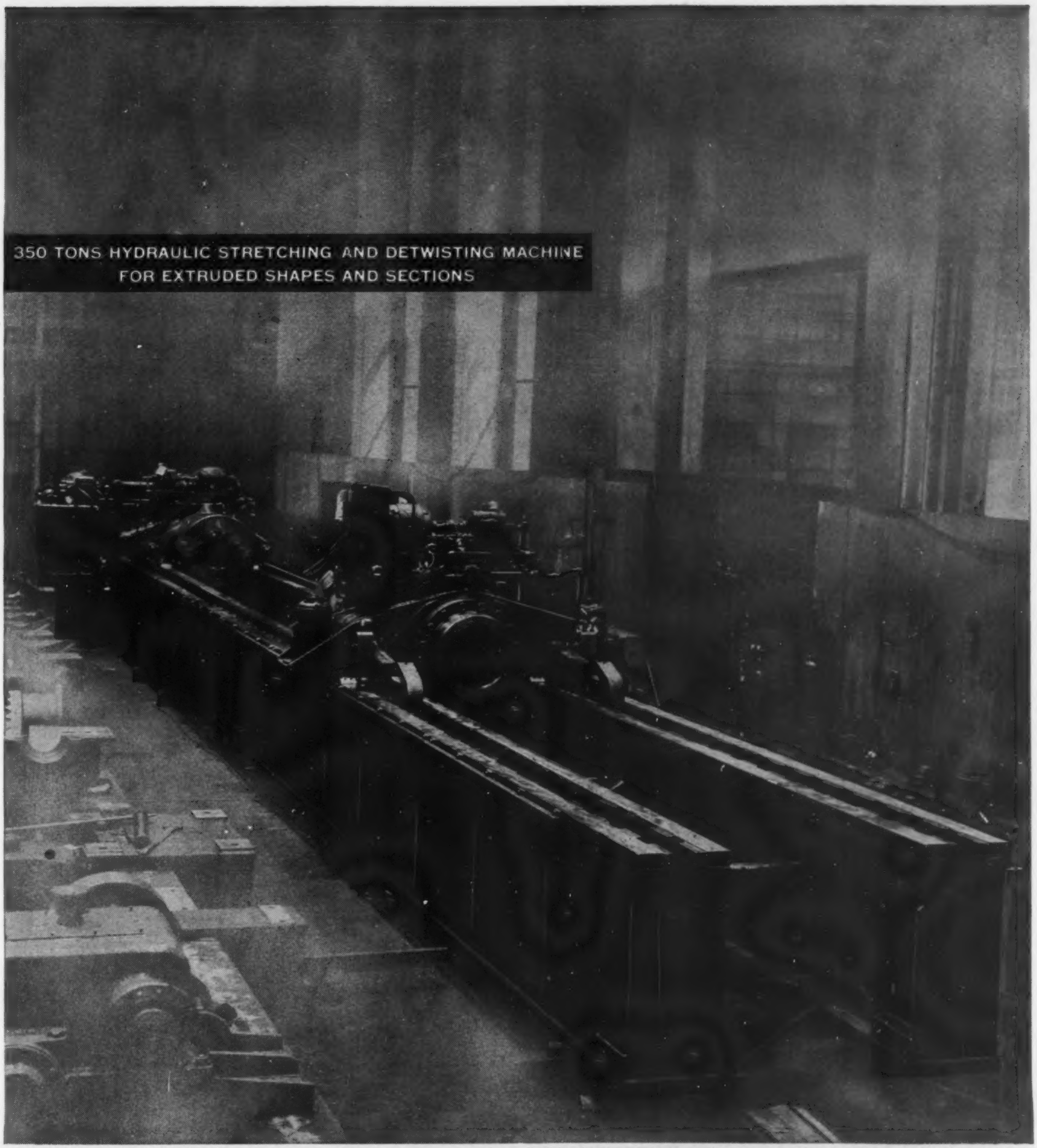
Here at National we unite the science of metallurgy with the craftsmanship of the artisan. In our modernly equipped plant and laboratory we handle the abstract with almost the same dispatch as the routine. Whether it be rolls for sheet, strip, plate or shapes—or heavy castings of complex character, look to National for the highest standards of engineering and manufacturing ability.

*National Rolls*

**THE NATIONAL ROLL & FOUNDRY CO.**

**AVONMORE, PENNSYLVANIA**

*Manufacturers of* ALL GRADES OF CAST ROLLS • IRON & ALLOY IRON STEEL & ALLOY STEEL • HEAVY IRON & STEEL CASTINGS • ROLLING MILL EQUIPMENT



350 TONS HYDRAULIC STRETCHING AND DETWISTING MACHINE
FOR EXTRUDED SHAPES AND SECTIONS

HYDROPRESS · INC.

*ENGINEERS* *CONTRACTORS*

**HYDRAULIC PRESSES · ROLLING MILLS**
**STRETCHERS · PUMPS · ACCUMULATORS**

*570 LEXINGTON AVENUE • NEW YORK • N. Y.*

## EC&M TYPE WB BRAKE

# Solves the A-C BRAKE Problem

*....gives better* PERFORMANCE *too...*

Rectifier - Unit in compact form for separate mounting on existing installations.

*M*ANY users of a.c. motor-driven cranes, hoists and machinery are switching to the EC&M Type WB Brake with rectifier-unit. Its *high-speed performance* and *reduced up-keep* for a.c. circuits have prompted its nationwide acceptance. Repeat orders indicate standardization on the WB Brake wherever a.c. brakes are needed.

These brakes not only eliminate the laminated members required in a.c. brake design, but give quick response. High initial current insures *fast release;* automatic reduction of the holding current results in *fast setting*.

The rectifier-unit is compact and is arranged for separate mounting for existing installations. On new projects, it may be combined with the motor control panel. Bulletin 1006 gives complete details on WB Brakes for a.c. operation. Bulletin 1004-D describes them for d.c. service.

**THE ELECTRIC CONTROLLER AND MANUFACTURING CO.**

**2698 East 79th Street** **Cleveland 4, Ohio**

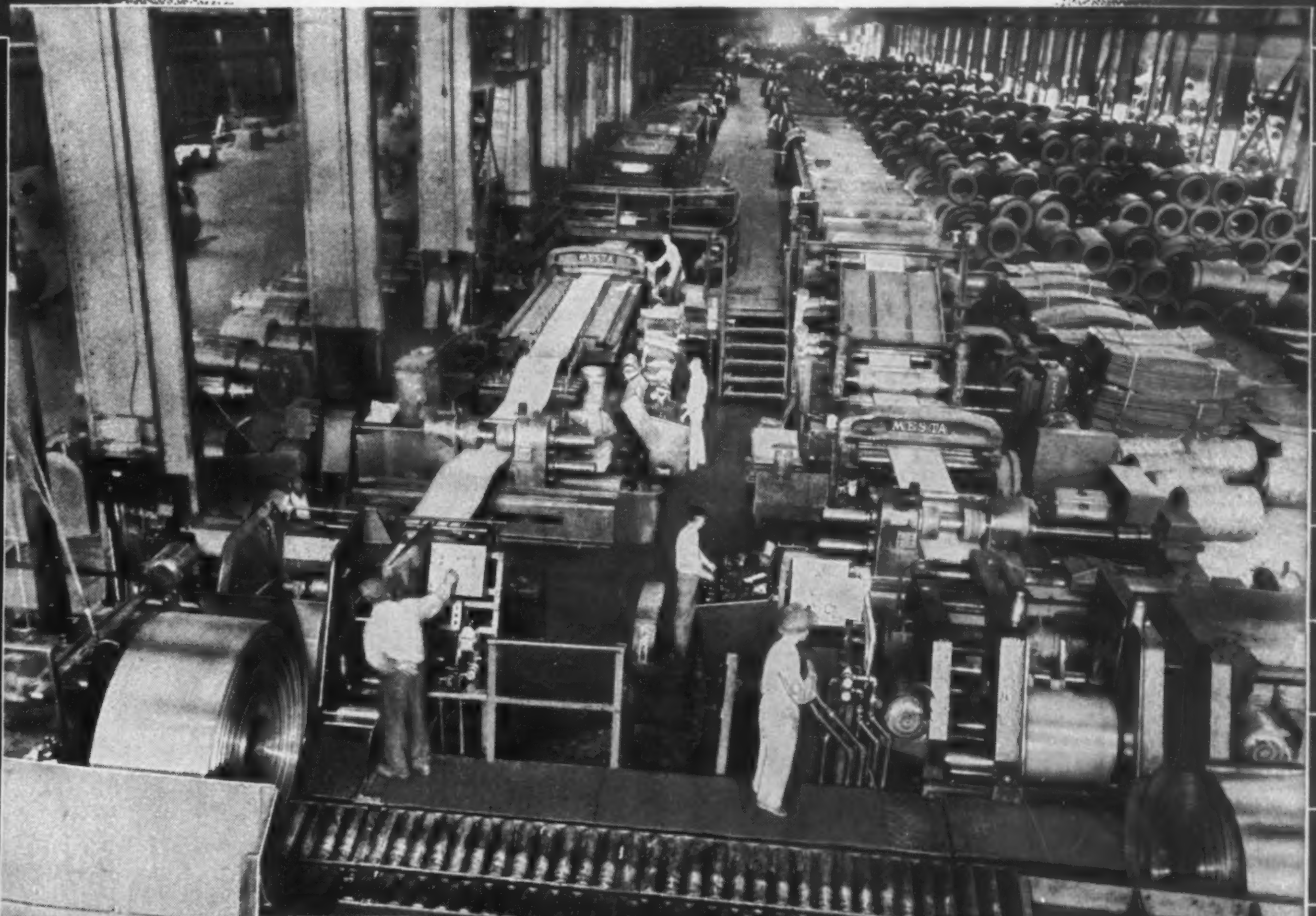
### REDUCED UP-KEEP *and* BETTER OPERATION

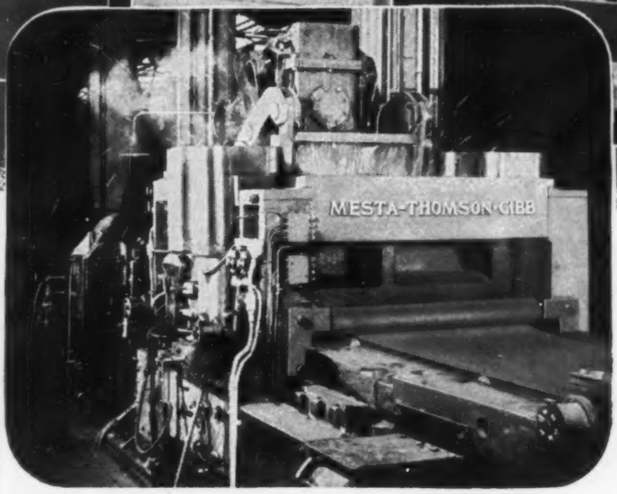
*because*

No laminated magnets or plungers.
No destructive hammer-blow.
No a.c. chatter.
No coil burn-out due to shoe-wear affecting air-gap.
No motors, gears or pumps.
Has fast release and fast set.
Has ability to permit accurate inching.
Has hand release.
Has solid cast-steel magnet and armature.
Has short armature-movement.
Has thick, molded brake blocks 1/4" to 3/4" thick.

**On Cranes, Hoists and Machinery ...the EC&M Type WB Brakes *give* HIGH SPEED PERFORMANCE —REDUCED UP-KEEP**

# Continuous pickling lines *built by* MESTA





The Mesta-Thomson-Gibb Flash Welder, located at the entry end of continuous pickling lines, produces heavier coils with butt welded joints suitable for cold rolling on high speed mills.

A Mesta Continuous Pickling Line delivers greater tonnage of strip steel. This is due not only to the design and sturdiness of the individual units, but also to correct engineering of the entire process.

★ BUY VICTORY BONDS ★

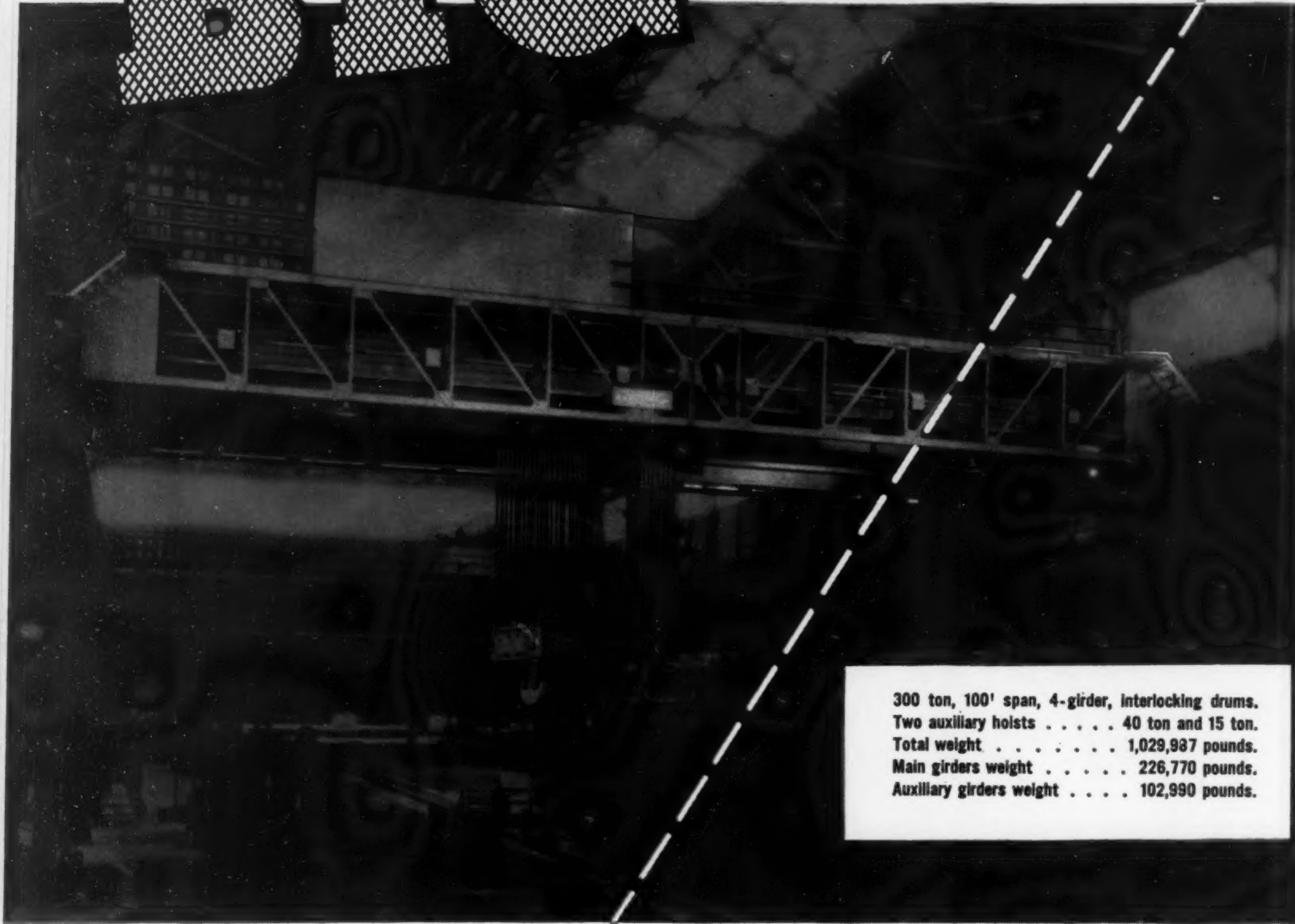
ARMY E NAVY

The Army-Navy "E" Flag with five stars flies over the Mesta Plant

**MESTA MACHINE COMPANY**

PITTSBURGH, PENNSYLVANIA

# BIG CRANES



300 ton, 100' span, 4-girder, interlocking drums.

| | |
|---|---|
| Two auxiliary hoists | 40 ton and 15 ton. |
| Total weight | 1,029,987 pounds. |
| Main girders weight | 226,770 pounds. |
| Auxiliary girders weight | 102,990 pounds. |

Alliance builds *large* Cranes for handling *heavy* loads safely.

Here's a 300 ton, 100' span, 4-girder Alliance crane to move *completely assembled* Mill Housings. Two auxiliary hoists, 40 tons and 15 tons, add additional lifting and operating power.

Look over some of the heavyweights Alliance has built in the past couple of years:

4-Girder Ladle Cranes—Capacity 100 to 300 tons.
Soaking Pit Cranes—Capacity 10 to 60 tons.
Ingot Chariots—Capacity 5 to 60 tons.
Charging Machines—Capacity 1 to 20 tons.
Electro-hydraulic Cranes—Capacity 200 to 300 tons.
Ordnance Plant Cranes—Capacity 125 to 200 tons.
Forging Manipulators—Capacity 1 to 75 tons.
. . . plus several giants for the nation's shipyards.

During half a century's experience building the World's Largest Cranes, The Alliance Machine Company has developed many new Safety and Mechanical Features, which are now incorporated as standard practice in Steel Mill Cranes.

ARMY E NAVY

*Consult Alliance on Cranes.*

THE ALLIANCE MACHINE COMPANY, ALLIANCE, OHIO · PITTSBURGH, 1622 OLIVER BLDG.

LADLE CRANES • GANTRY CRANES • FORGING MANIPULATORS • SOAKING PIT CRANES
STRIPPER CRANES • SLAB AND BILLET CHARGING MACHINES
OPEN HEARTH CHARGING MACHINES

**Alliance**

# 2 result-getting cables *ENGINEERED BY OKONITE*

A
cost-reducer
in
plant maintenance

A
piler-up
of long
service records

## OKOLITE-OKOPRENE WIRING

Okolite-Okoprene* wires and cables, because of their versatility and low maintenance, are excellent for all-around service.

Millions of feet of Okolite-Okoprene wires and cables have proved long-lived under widely differing conditions of operation. Okolite provides a moisture-resistant insulation possessing advantageous electrical properties, Okoprene a non-flammable neoprene protective jacket. Cables of this durable construction are resistant not only to acids but to alkalies, other chemicals and oil. Write for Bulletin OK-2009C.

*U. S. Pat. No. 2,312,058

## OKOCORD PORTABLE CORDS

You can count on Okocord to deliver full power reliably wherever a portable cord is given plenty of use and abuse. In the servicing of tools, magnets, welding equipment and machinery, to name a few of many examples, Okocord offers the mechanical strength to pile up records of long, outstanding performance.

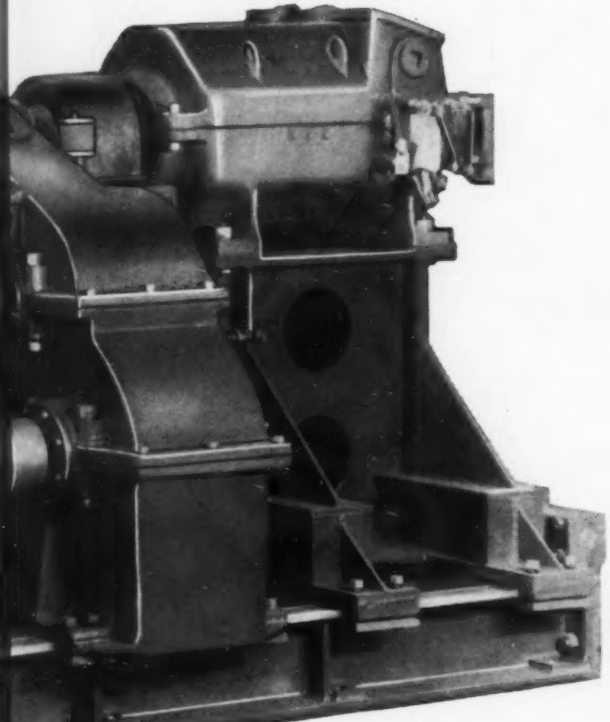
Okocord has the flexibility which is the first requirement of a portable cord, fine copper wires being rope-stranded. It is protected by a sheath of Okoprene. Write for Bulletin OK-2011. The Okonite Company, Passaic, N. J.

**OKONITE** OKONITE SINCE 1878 **insulated wires and cables**

4450

new
4"a
ey
Designed with an
BIRDSBORO
BIRD ROLL ADJUSTMENT—PATENTED

# 4" angle straightener by BIRDSBORO-
# eye to speed and accuracy.



Here is the latest design in a machine of this type. Because of its patented end roll adjustment, the operator maintains quick and easy control of the rolls while the machine is in operation. This provides for speed in production and holding the work going through to close tolerances.

This machine has four bottom and four top working rolls and is also equipped with a set of vertical idler rolls. The four bottom rolls and one top roll on entry end of machine are driven through universal spindles. The straightening rolls are made up of discs mounted on steel mandrels. Anti-friction bearings are used throughout.

This is another example of the modern development work being done at Birdsboro—an activity you may well investigate when you are thinking of replacing worn-out equipment or adding to your plant facilities. Put your problem into the hands of Birdsboro design-engineers for a practical solution.

**BIRDSBORO STEEL FOUNDRY AND MACHINE COMPANY, BIRDSBORO, PA.**

Manufacturers of Steel Mill Equipment, Iron and Steel Rolls, Hydraulic Presses, Crushing Machinery, and Special Machinery

**BIRDSBORO**

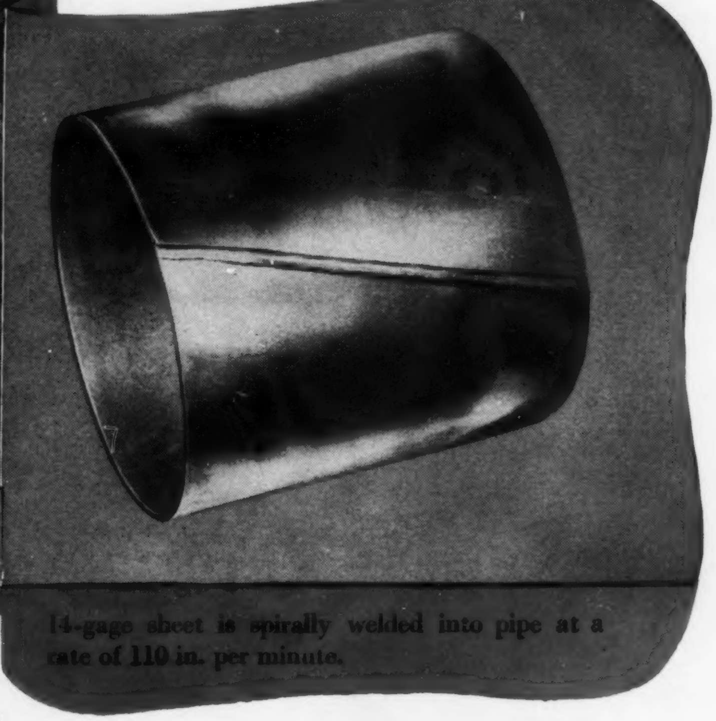
**STEEL MILL EQUIPMENT**

*Linde's*

# UNIONMELT WELDING PROCESS

## *Speeds Joining of Metal*

4½-in. steel slabs for diesel switcher underframes are welded in two passes.



14-gage sheet is spirally welded into pipe at a rate of 110 in. per minute.

**18-GAGE SHEET** can be welded at 240 in. or more per minute.

**ONE-PASS WELDS** even 3 in. thick can be made.

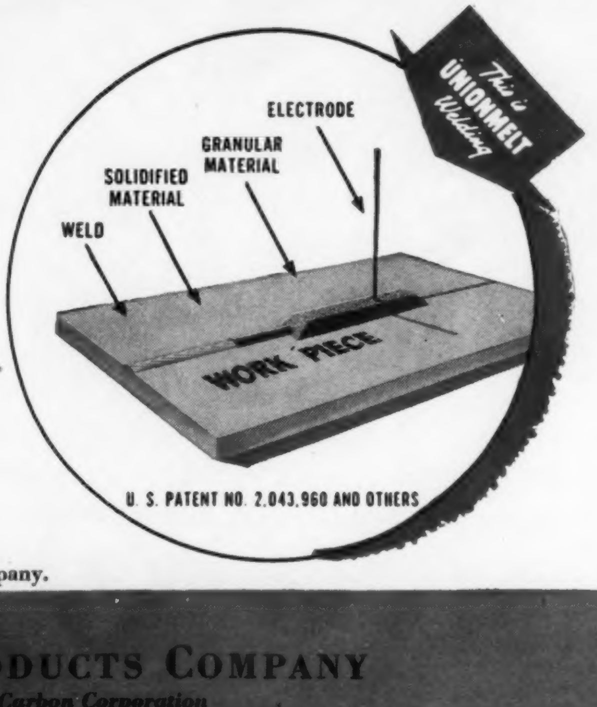
**WELDING CURRENTS** up to 4,000 amperes or more, a.c. or d.c. can be used.

**BUTT, TEE AND LAP FILLETS,** plug and molded welds can be made.

**MINIMIZED DISTORTION** is a result of high speed, narrow weld zone, and concentrated heat.

**NO METAL LOSS** from spatter or vaporization is encountered.

Anyone who wishes to use this patented invention may do so under Linde's standard license agreement. Send for a copy of the new UNIONMELT book, Form 6077.


This is UNIONMELT Welding
ELECTRODE
GRANULAR MATERIAL
SOLIDIFIED MATERIAL
WELD
WORK PIECE
U. S. PATENT NO. 2,043,960 AND OTHERS

The word "Unionmelt" is a trade-mark of The Linde Air Products Company.

**THE LINDE AIR PRODUCTS COMPANY**

*Unit of Union Carbide and Carbon Corporation*

30 E. 42nd St., New York 17, N. Y. UCC Offices in Other Principal Cities

In Canada: Dominion Oxygen Company, Limited, Toronto

# BATTERY TRUCKS need less attention

# ...ALKALINE BATTERIES

# give most trouble-free power

Tiering of materials to the ceiling permits maximum utilization of storage space. This is a stop-and-go handling job in which battery trucks excel because of their inherent flexibility and dependable operation.

THE performance of American industry during the war furnished convincing evidence of the superior dependability and high availability of battery-powered material handling trucks. They stayed on the job 24 hours a day—day in and day out—with an amazing regularity that many users thought was impossible until they saw it demonstrated. Here's why:

The electric drives in a battery truck are inherently simple, have few moving parts to require repair and replacement, and are free from wear-and-tear vibration. Exchange batteries keep the truck continuously supplied with power, so except for a few minutes to change batteries two or three times per 24-hour period, the truck need not stop working for servicing of its power unit.

Besides requiring less attention, the battery truck is also economical to operate. It uses power most efficiently because it starts instantly, accelerates rapidly, and consumes no power during stops. The current used for charging its battery is the lowest-cost power available.

Because of these inherent advantages, the battery truck is therefore a most dependable and efficient material handling unit . . . especially when powered by Edison Alkaline Batteries. With steel cell construction, a solution that is a preservative of steel, and a foolproof electrochemical principle of operation, they are the longest-lived, most durable and most trouble-free of all industrial truck batteries. Edison Storage Battery Division of Thomas A. Edison, Incorporated, West Orange, N. J. In Canada: International Equipment Co. Ltd., Montreal and Toronto.

**Edison**
**ALKALINE BATTERIES**

# *Airco Oxygen...*

## ...ALL YOU NEED...WHEN YOU NEED IT!

Whether you need a hundred cubic feet or a million . . . whether you need an occasional cylinder or a constant supply of high purity oxygen . . . there's an Airco depot near you ready to meet all your requirements – with the right type of "package."

If your consumption of oxygen is large, the Airco trailer delivery system offers the greatest measure of convenience and economy. Oxygen is available in trailer capacities of approximately 10,000, 20,000, and 40,000 cubic feet. These can be placed at any suitable location of your plant.

If your consumption is moderate or small, Airco oxygen is delivered in standard steel cylinders in whatever number and frequencies best serve you. But whether small or large, your requirement is filled the way you want it.

Airco has always pioneered in the creation of new and better methods of oxygen delivery – and *Airco looks to the future!* Tomorrow, you can expect even more important improvements – thanks to Airco's foresighted research and development program.

For assistance in developing or improving an internal gas distribution system geared to your operations . . . talk with an Airco technical man. Write your nearby Airco office, or: Air Reduction, 60 E. 42nd St., New York 17, N. Y. In Texas: Magnolia Airco Gas Products Co., Houston 1, Texas.

**AIR REDUCTION**
**60 East 42nd Street**
**New York 17, N. Y.**

*An interesting booklet . . . "Oxygen — Indispensable Servant of Industry" . . . is available. Fill in and mail this coupon for your copy.*

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AIRCO **AIR REDUCTION**

*Offices in All Principal Cities*

**ORIGINATORS OF MODERN OXYACETYLENE METHODS FOR THE METAL WORKING INDUSTRY**

VACUUM CLEANERS · WASHING MACHINES · ELECTRIC FANS
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FOOD AND DRINK MIXERS · REFRIGERATORS · POWER SANDERS
PHONOGRAPHS · ELECTRIC SAWS · CALCULATING MACHINES
An Invitation
FOOD AND DRINK MIXERS · REFRIGERATORS

# to makers of fractional-horsepower motor appliances!

MANY manufacturers have solved their fractional-horsepower motor brush problems for their new appliances simply by putting it up to National Carbon Company's brush-testing laboratory.

We invite you to do the same! This will relieve you of making countless and costly "elimination tests." And it will assure application of the most suitable brush grade for your motor.

You can rely on this service because National Carbon has been working out brush problems of every conceivable type for over 50 years. In addition, National Carbon's modern laboratory for testing fractional-horsepower motor brushes is equipped with the latest in test facilities, and is staffed by experts.

***Moreover, your tests will be run as you would run them yourself — under your own specified load, cycle, and other operating conditions.***

Accept this invitation! It can mean better performance for your appliances. Send in your motors—tests will be made promptly. Naturally, there is no obligation.

If you wish more information on these tests, get in touch with our nearest Division Office.

*Here is the modern laboratory where your brush problem can be solved quickly, correctly . . . at a big saving in trouble for you!*

*The word "National" is a registered trade-mark of*

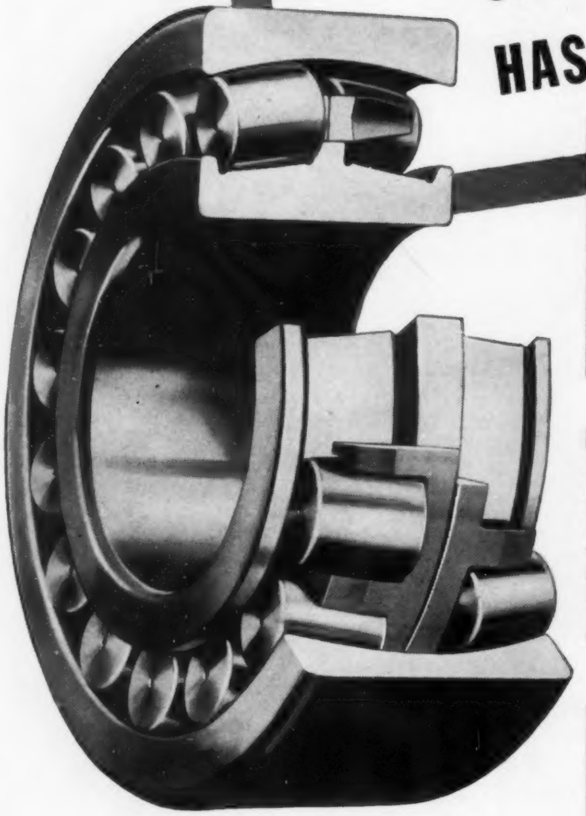
**NATIONAL CARBON COMPANY, INC.**

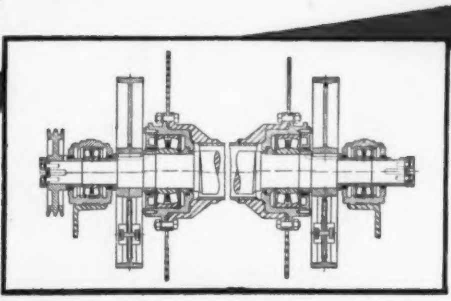
*Unit of Union Carbide* UCC *and Carbon Corporation*

GENERAL OFFICES: 30 East 42nd Street, New York 17, N. Y.

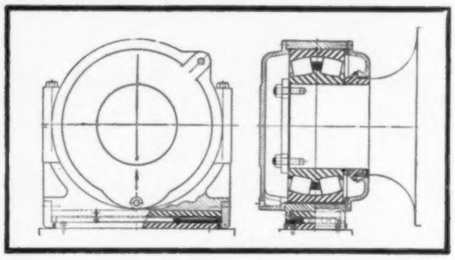
DIVISION SALES OFFICES: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

# TORRINGTON SELF-ALIGNING SPHERICAL ROLLER BEARING HAS MANY APPLICATIONS





**CONSTRUCTION...** This X-section drawing shows a mounting of four Torrington Self-Aligning Spherical Roller Bearings on the main eccentric shaft of a shaker screen. The self-aligning feature of the bearings easily compensates for distortion and satisfactorily handles heavy shock loads.



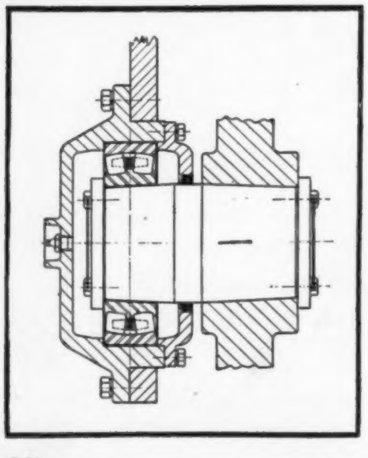
**PAPER...** Shown here in X-section is a Torrington Self-Aligning Spherical Roller Bearing as applied to a paper calender bottom roll, with a ladder bearing utilized under the floating housing to permit it to move freely when the roll expands or contracts.

Of major importance to design engineers and users of machinery in which friction poses a serious problem is the versatility of the Torrington Self-Aligning Spherical Roller Bearing . . . .

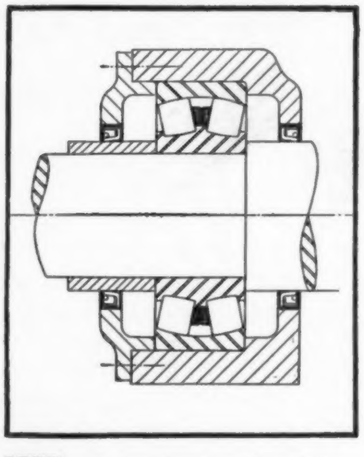
★

The engineering staff of Torrington's Bantam Bearings Division is prepared to offer you practical, cost-saving suggestions for adapting the high-capacity Self-Aligning Spherical Roller Bearing to the machines you design, build or operate. For further information write for our Bulletin No. 100A or contact your nearest Torrington Representative.

THE TORRINGTON COMPANY
BANTAM BEARINGS DIVISION
SOUTH BEND 21, INDIANA



**OIL...** The accompanying drawing illustrates a wrist pin application of the Torrington Self-Aligning Spherical Roller Bearing as used for oil field pumping units. Distortion in the pitman does not affect the efficient functioning of the bearing in this mounting.

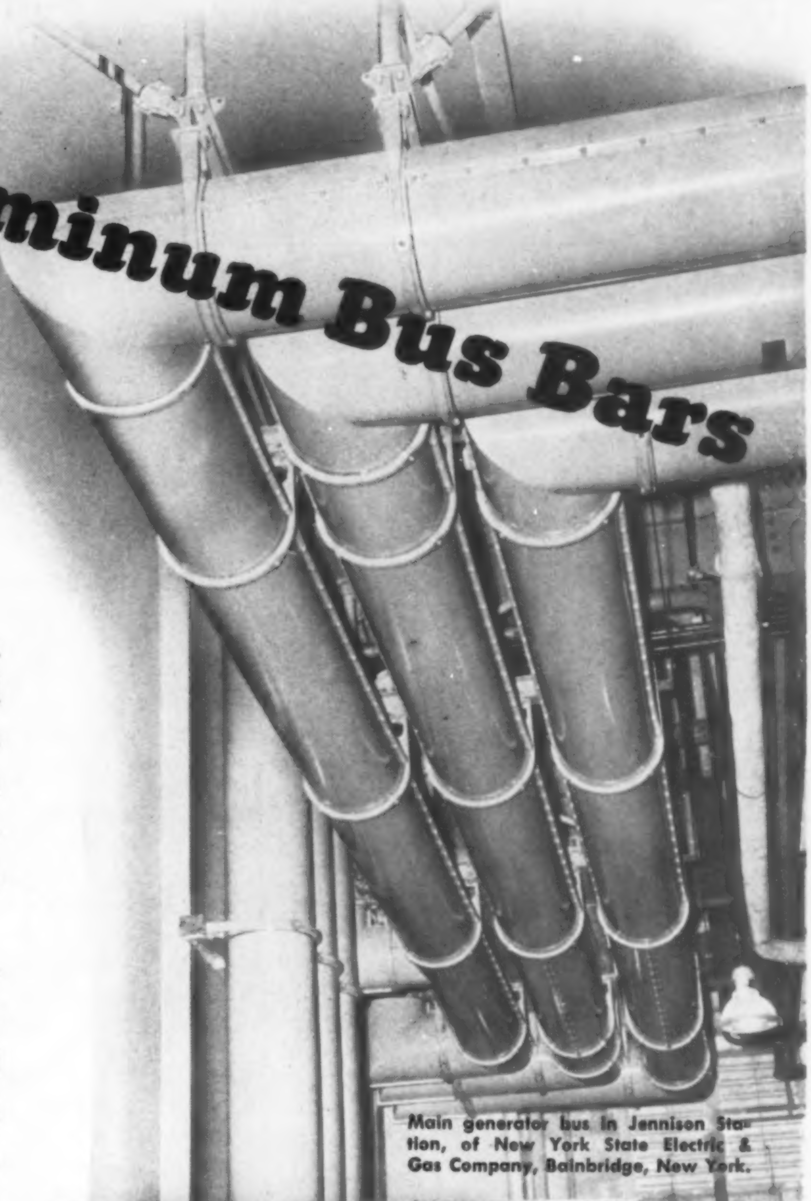


**STEEL...** X-Section drawing shows a typical arrangement for the Torrington Self-Aligning Spherical Roller Bearing in modern, high speed auxiliary equipment for steel mills. Temperature changes, misalignment and high load stresses do not affect the free-rolling action within the bearing.

**TORRINGTON BEARINGS**

**SPHERICAL ROLLER • STRAIGHT ROLLER • TAPERED ROLLER • NEEDLE • BALL**

# Alcoa Aluminum Bus Bars

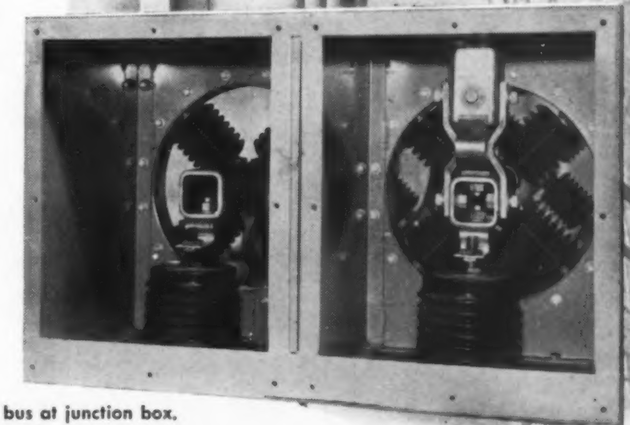

Main generator bus in Jennison Station, of New York State Electric & Gas Company, Bainbridge, New York.

## *Housed in Aluminum and Supported by Aluminum Brackets*

● Here's Aluminum's best known property—light weight—employed to full advantage. Bus bars, hangers and housings are all made of Alcoa Aluminum, thereby simplifying installation and reducing the burden on supporting structures.

Of equal importance to the electrical engineer, housings are nonmagnetic and heat is dissipated rapidly. Alcoa Aluminum bus bars have high electrical conductivity.

Indoor or outdoor substation, low capacity or high, Alcoa has the structural materials you'll require. For quotations, call the nearby Alcoa sales office, or write ALUMINUM COMPANY OF AMERICA, 2128 Gulf Bldg., Pittsburgh 19, Pa.


Showing insulators supporting bus at junction box. Bus bars are 3½" square Alcoa Aluminum tubing.

**ALCOA FIRST IN ALUMINUM**

# Troubled with Balky Arc Furnace Electrodes?

Fast-Acting,

Accurate

"Regulex" Control

Eliminates Six

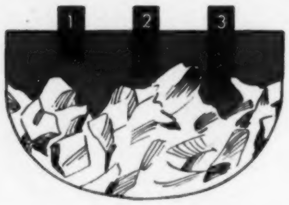
Furnace "Bugs"

Due to Faulty

Electrode

Action

## MELTDOWN PERIOD

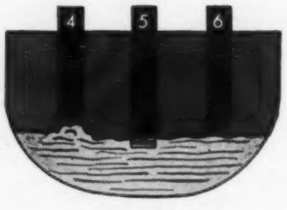


1. **REPEATED ARC INTERRUPTION,** due to sudden "settling" of metal. Sensitive "Regulex" generators continually adjust electrode position to meet rapidly changing furnace conditions—thus reduce number of arc restrikes required.

2. **INSTABILITY OF ARC,** due to inaccuracy of control for raising an electrode when a short circuit occurs. "Regulex" variable voltage control raises electrodes *just the right amount*—keeps arc values constant and increases furnace output per kilowatt-hour input.

3. **BREAKAGE OF ELECTRODES,** caused by caving in of metal charge against electrodes. Fast-acting "Regulex" control pulls electrodes safely out of a cave-in. "Regulex" generators also limit mechanical shock to electrodes, by reducing time required to strike a steady arc.

## REFINING PERIOD



4. **WASTE OF POWER,** as a result of current surges when metal boils up against electrodes. "Regulex" variable voltage control chops off current peaks . . . lower total power input results.

5. **FREEZING OF ELECTRODES** in molten bath, due to electrode "drift" when a-c power fails. Only the "Regulex" generator set is provided with a flywheel for automatically raising electrodes upon a power failure...prevents electrode breakage.

6. **BURNING OF ELECTRODES** during refining period, due to using too short an arc. Accurate "Regulex" control permits use of longer arc—saves electrodes.

Your arc furnace manufacturer will be glad to tell you about "Regulex" furnace control. Or write directly to ALLIS-CHALMERS, MILWAUKEE 1, WIS.

## Save Money with "Regulex" Arc Furnace Control!

**EXTRA MELTS**
"Regulex" variable voltage control means accurate and rapid adjustments in electrode position. Result is that a stable arc is struck in less time. Often, one or more additional furnace melts are obtained per day.

**LESS POWER WASTE**
"Regulex" generators, with their instant response to changing furnace conditions, help eliminate wasteful current peaks . . . give you maximum arc furnace output with minimum kilowatt-hour input.

**LONGER ELECTRODE LIFE**
Fewer arc restrikes, less danger from cave-ins, plus the flywheel feature of the "Regulex" set which prevents "freezing" of electrodes—all these factors add to the life expectancy of your furnace electrodes!

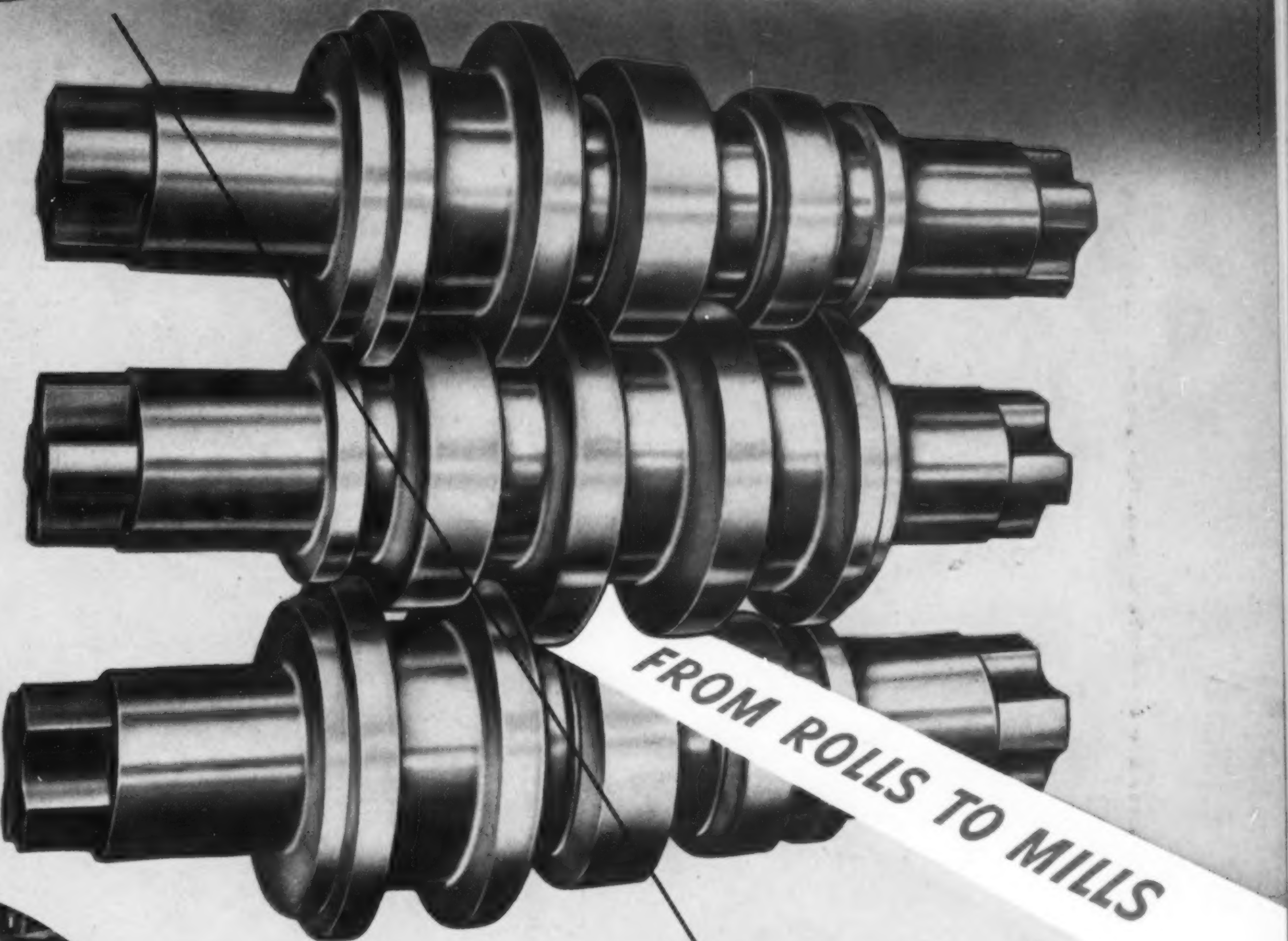
# Allis-Chalmers

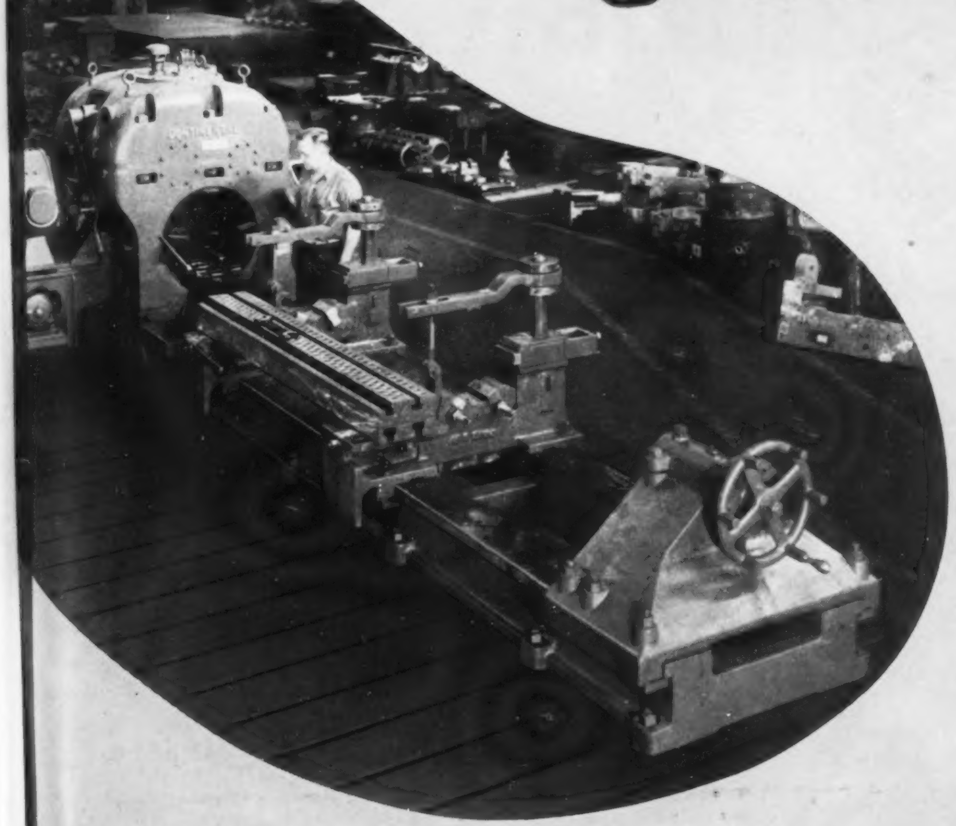
**MILWAUKEE 1, WIS.**

A 1940

**HEAR THE BOSTON SYMPHONY:** ***Every Saturday Evening, American Broadcasting Co.***

# Continental





## Designs and Builds Dependable Equipment for Progressive Steelmakers

CONTINENTAL—*a single, dependable source* for hot and cold ferrous or non-ferrous rolling mills, the correct rolls, accessories and equipment for low cost operation.

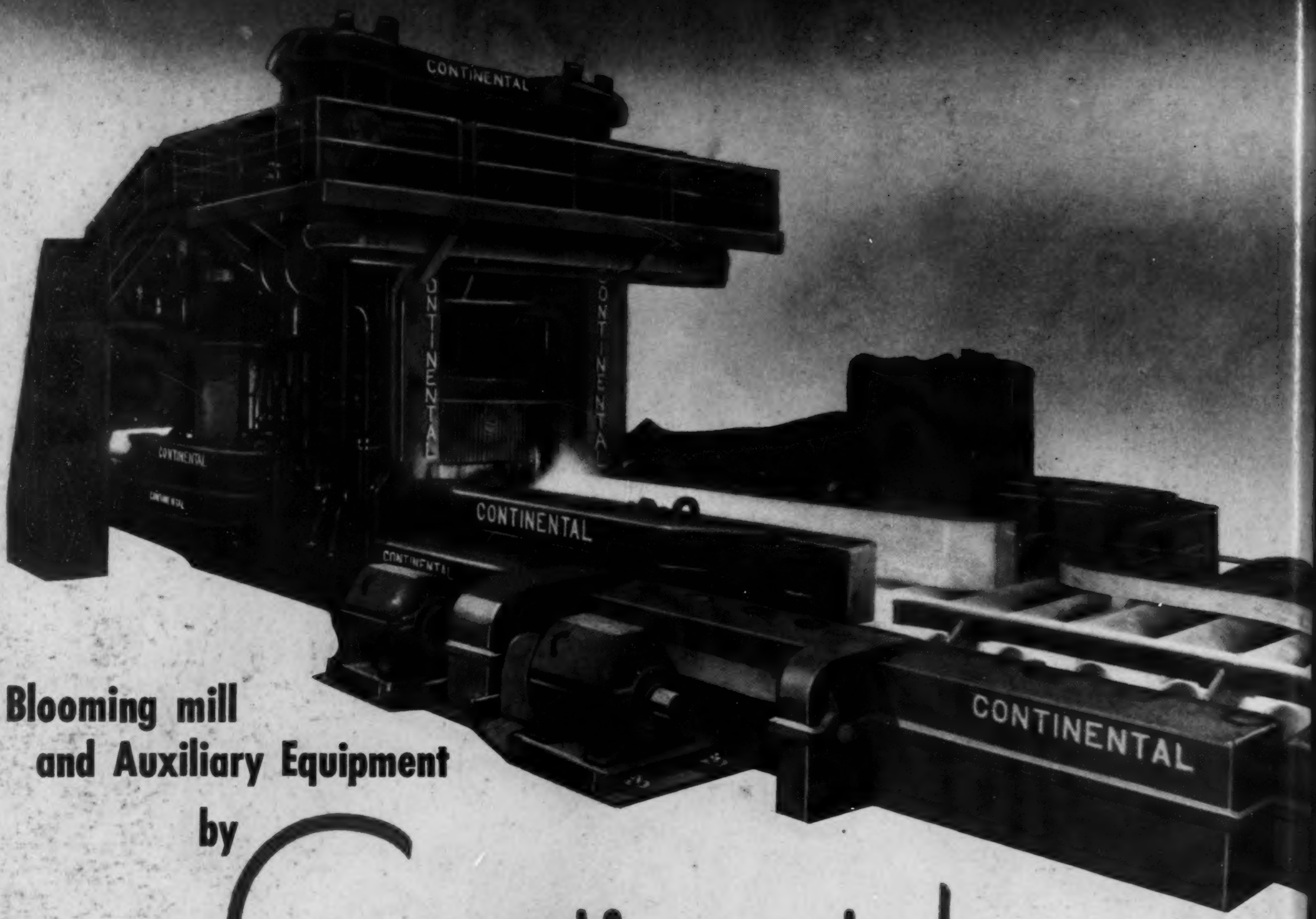
Continental

**Continental**

**FOUNDRY & MACHINE CO.**

*Pittsburgh • Chicago*

**Plants at: E. Chicago, Ind. - Wheeling, W. Va. - Pittsburgh, Pa.**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**Blooming mill and Auxiliary Equipment by**

**Continental**

*Engineered for maximum production, longer trouble-free service — and to the specific job requirement.*

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For any ferrous or non-ferrous rolling operation — CONTINENTAL engineers offer world-wide experience in the selection of correctly designed equipment for your specific production problems.

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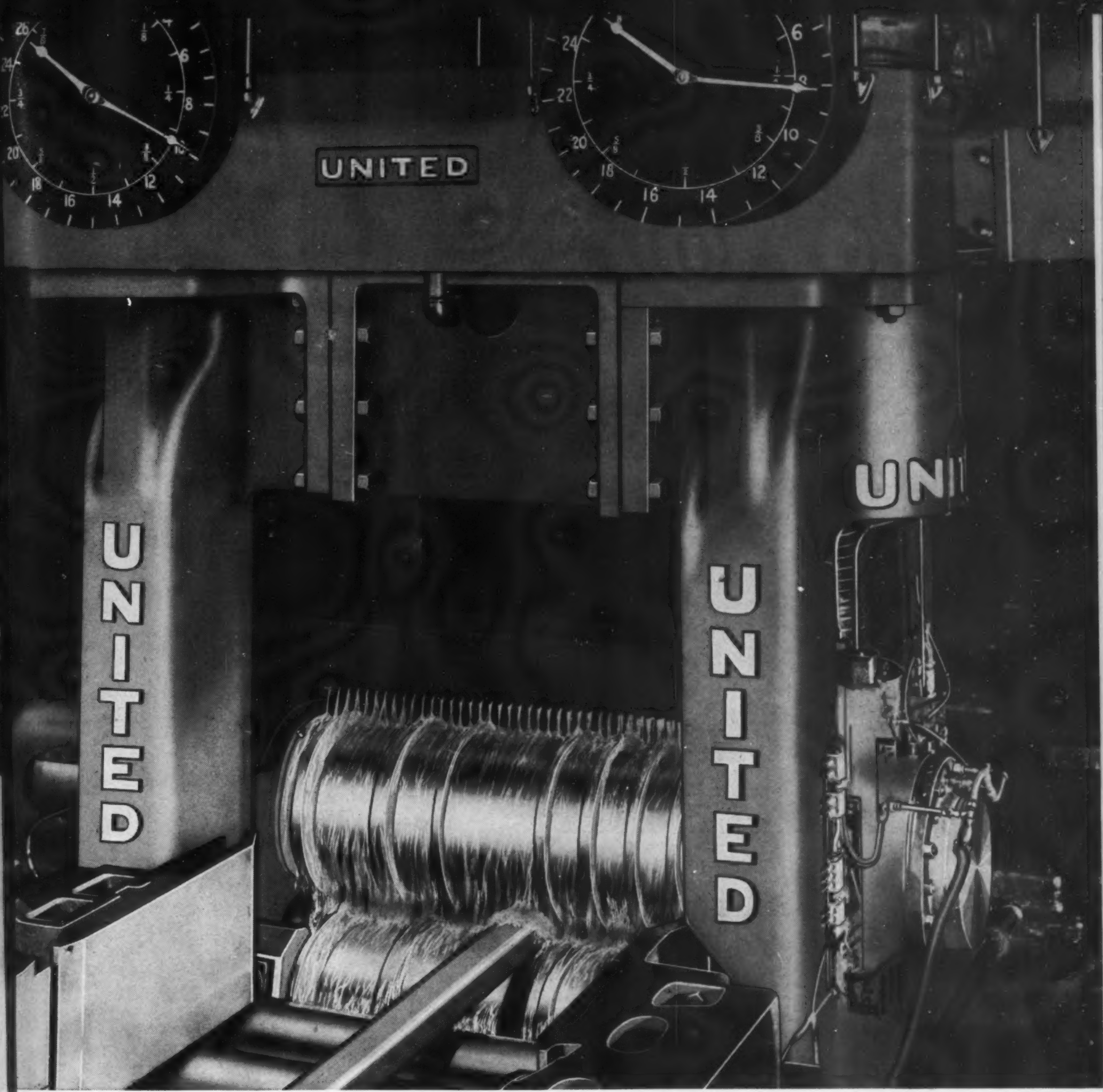


# UNITED 38″ Blooming Mill

UNITED has built all types of mills and auxiliary equipment for practically every prominent rolling mill interest in the ferrous and non-ferrous industries, as well as for dozens of lesser plants engaged in the rolling of metals of every conceivable shape and analysis. Mill and equipment designs for standard or special rolling applications, range from projects of massive weight and strength to those of extreme precision and finest accuracy.

As specialists in the creation, manufacture and application of rolling processes, UNITED engineers may render valuable assistance in solving *your* problems. Consult them freely without obligation.

**UNITED ENGINEERING AND FOUNDRY CO.**

**PITTSBURGH, PENNSYLVANIA**

**The World's Largest Designers and Makers of Rolls and Rolling Mill Equipment**

Plants at Pittsburgh · Vandergrift · New Castle · Youngstown · Canton

Subsidiary: Adamson United Company, Akron, Ohio

Affiliates: Davy and United Engineering Company, Ltd., Sheffield, England

Dominion Engineering Works, Ltd., Montreal, P.Q. Canada

# Inspect your bars and billets on a mechanized table—save time and money!

Mill Superintendents quickly recognize money-and-time-saving advantages of the new Bonnot Inspection Table. Whenever quantity inspection occurs, this rugged and efficient equipment speeds up bar and billet inspection . . . keeps production running with assembly-line smoothness.

Hydraulic manipulators easily enable one man to handle complete inspection . . . and do it quicker than is possible with older, time consuming methods.

A few simple push-button operations bring bar or billet into position and quickly turn it for overall inspection. Usable billets are then mechanically moved onto storage skids to await chipping or other disposition. Scrap billets are run out on the reject platform.

For complete details, write today to The Bonnot Company, Steel Equipment Division, Canton 2, Ohio.

**BILLETEER OWNERS**

Increase productiveness of your Billeteers with this new table. By feeding a battery of Billeteers from one inspection table, you eliminate chipping dead-time occuring during billet inspection on roll table.

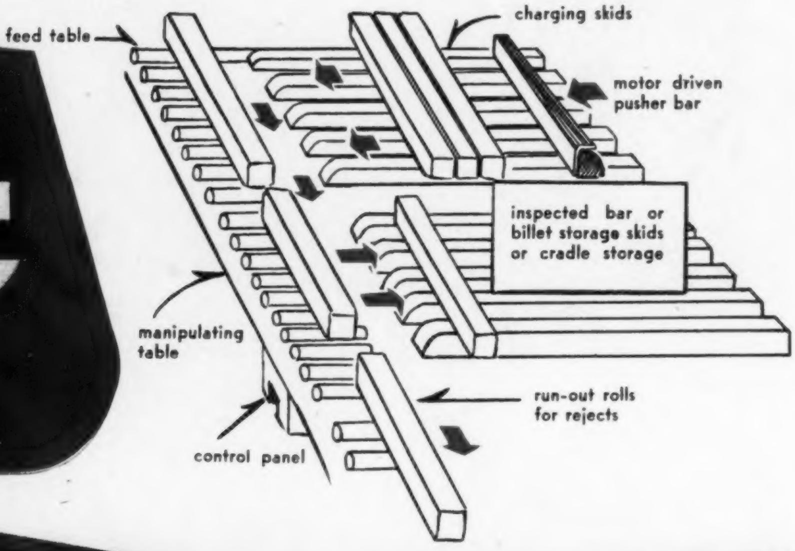
*Engineered* FOR IMPROVED PRODUCTION

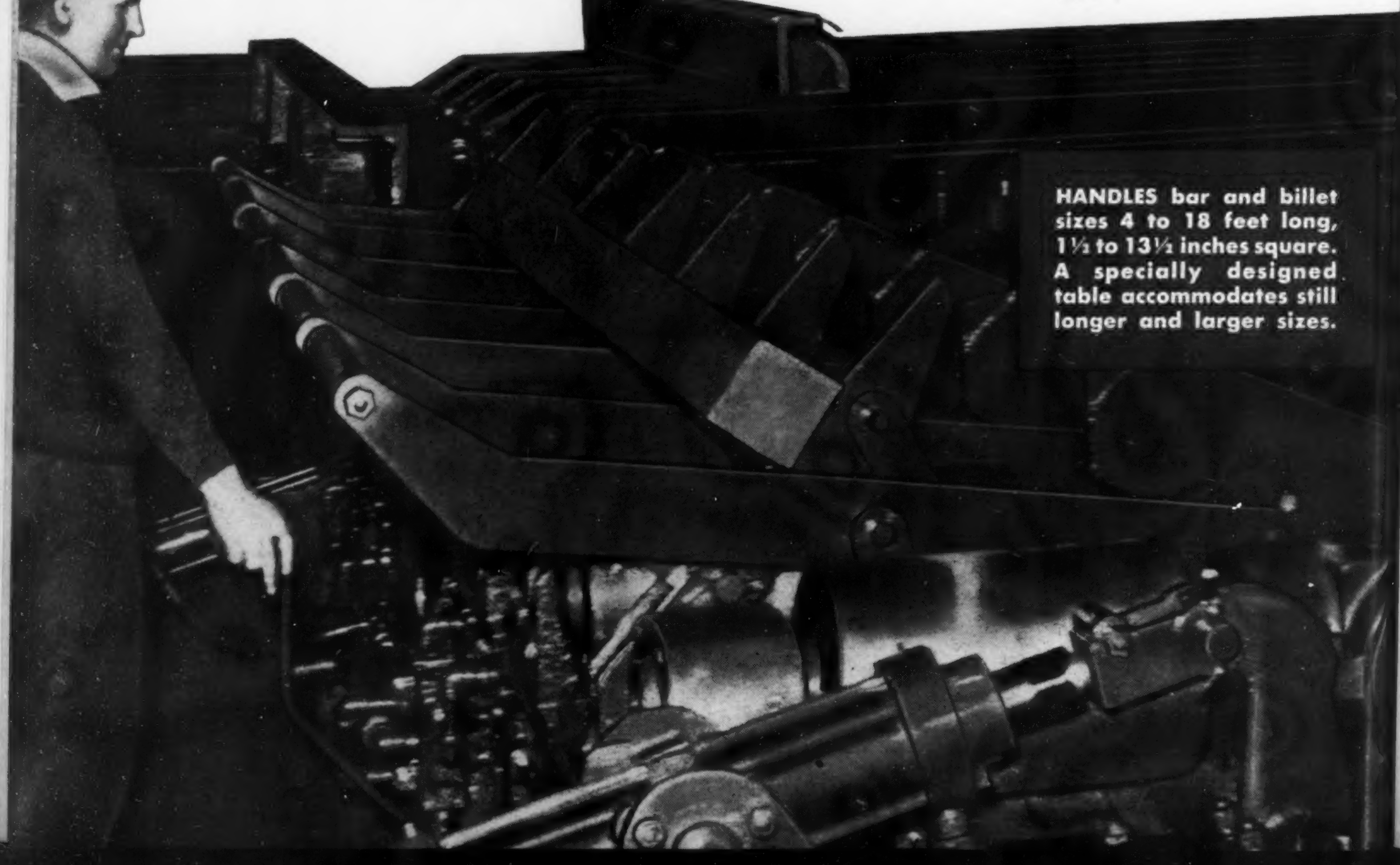
**Bonnot**

**THE BONNOT COMPANY**

*BUILDERS OF* **THE BILLETEER**

**CANTON 2, OHIO**


feed table
charging skids
motor driven pusher bar
inspected bar or billet storage skids or cradle storage
manipulating table
run-out rolls for rejects
control panel



**HANDLES bar and billet sizes 4 to 18 feet long, 1½ to 13½ inches square. A specially designed table accommodates still longer and larger sizes.**

F.E.I.
winning New laurels
in the fast PRODUCTION race

● In iron and steel plants, as well as in the non-ferrous field, wherever heat treating is done on a considerable scale, the F.E.I. Direct Fired System speeds production and reduces unit cost to a remarkable degree. This statement is fully borne out in every important installation so far made. In one large plant, where several different units were installed for test purposes, the F.E.I. won out by so wide a margin as to outdistance all competition and cause general astonishment. The records of F.E.I. performance speak for themselves—and they are yours for the asking.

Let F.E.I. engineers help you meet changing production plans and speed reconversion by making recommendations for converting present Cover Annealing Furnaces to the F.E.I. system, or installing new units.

**Direct-Fired Cover Annealing Furnaces for coiled strip, tin plate, flat sheets, wire and rod.**

•

**Spheroidizing, normalizing and bright annealing furnaces.**

•

**Galvanizing, patenting, lead annealing and salt furnaces for the wire industry.**

•

**Galvanizing furnaces for pipe, sheets and the jobbing trade.**

**FURNACE ENGINEERS, *Inc.***

***Specializing in the design, manufacture and installation of furnaces for the metal working industries***

1551 WEST LIBERTY AVENUE ★ PITTSBURGH, PA.

# UNLIMITED SPEED SELECTION AT THIS WIRE DRAW BENCH!

V•S Drive Control Unit
Adjustable-Speed Motor

*All operating functions, including adjustable-speeds are provided from plant's A-c. circuit on this Waterbury-Farrel Wire Draw Bench by a 5 Hp. Reliance V★S Drive.*

In the North Chicago plant of the Fansteel Metallurgical Corporation there is a draw bench which processes wire for many unusual purposes from such "story book" metals as tantalum, tungsten and molybdenum. And, because of the need for widely varied speeds under constant and absolute control, the Reliance V★S Drive has proved a "natural" for these delicate operations.

With V★S—an *all-electric, adjustable-speed drive operating from A-c. circuits*—unlimited speed variation with absolutely smooth acceleration and deceleration and automatic maintenance of proper tension are available. Automatic reversal can be provided at any desired point. Starting, stopping and speed changes are controlled from either nearby or remote stations.

Write for Bulletin 311, or call the nearest Reliance office for information about Reliance V★S Drive which may suggest how you can use it profitably in your own production operations, or in designing new production machinery.

**See the Operating Exhibit of the Reliance V★S Drive at the American Society of Tool Engineers Exposition • Cleveland, April 8-12**

## RELIANCE ELECTRIC & ENGINEERING CO.

**1084 IVANHOE ROAD • CLEVELAND 10, OHIO**

Birmingham • Boston • Buffalo • Chicago • Cincinnati • Denver • Detroit • Gary • Greenville • Houston • Kalamazoo • Kansas City • Knoxville • Los Angeles
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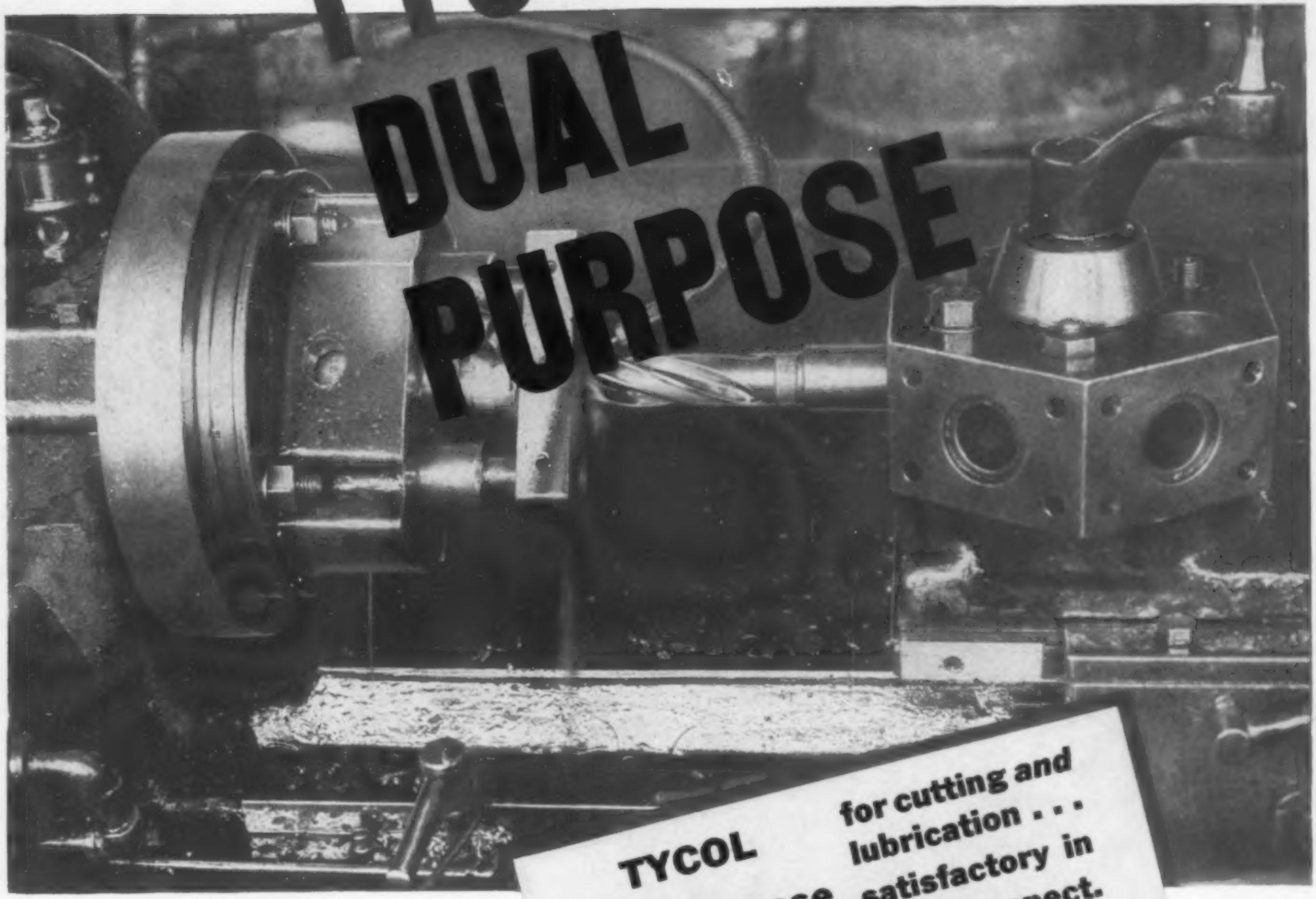
Tampa • Tulsa • Washington, D. C.

**"MOTOR-DRIVE IS MORE THAN POWER"**

# TYCOL DUAL PURPOSE

## ONE OIL — TWO JOBS FOR PRODUCTION ECONOMY



**TYCOL Dual-Purpose OIL** for cutting and lubrication . . . satisfactory in every respect.

"CUTTING SPEEDS ARE 25% FASTER..."

"AN EXCELLENT MACHINE LUBRICANT..."

"CORROSION IS BANISHED..."

"INCREASED TOOL LIFE..."

"IMPROVED FINISHES..."

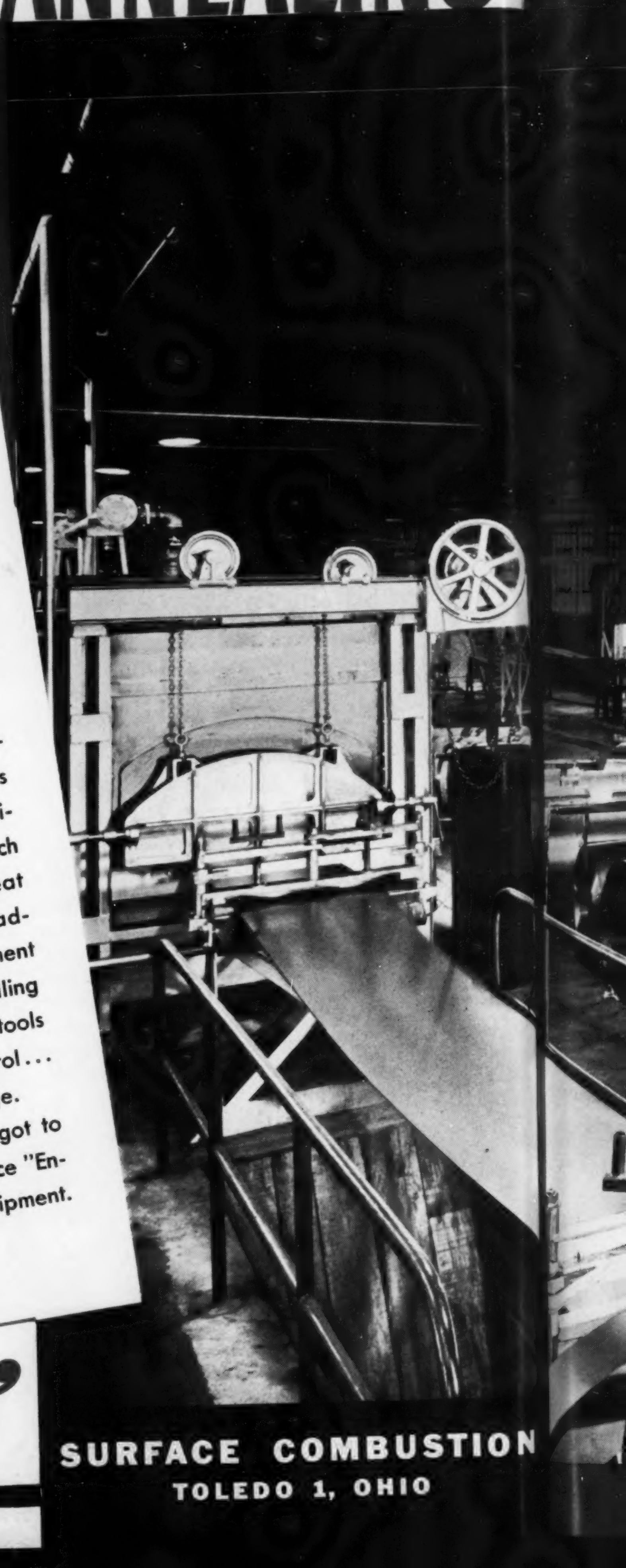
TYCOL INDUSTRIAL LUBRICANTS

Such outstanding results are the rule — not the exception . . . when a Tycol Dual-Purpose Oil is used . . . the one versatile oil that does the work of *two* oils better and more efficiently. Call, write or wire your nearest Tide Water Associated office for full details.

**TIDE WATER ASSOCIATED OIL COMPANY**
17 BATTERY PLACE · NEW YORK 4, N. Y.

Boston • Philadelphia • Pittsburgh • Charlotte, N. C.
Tide Water Oil Company of Canada, Ltd. • Toronto
Montreal

# *Continuous* ANNEALING



## "Surface" Roller Hearth Furnaces utilize Radiant Tube Heating and Controlled Atmospheres to provide a bright metal surface.

For many years "Surface" Radiant Tube Heating and "Surface" Prepared Gas Atmospheres have been the choice of the steel industry for the heat treatment of strip, sheet, rod and wire.

In the accompanying illustration the continuous-type Strip Annealing and Normalizing furnaces were designed for quality and quantity production. The complete heat treating cycle . . . heating, cooling and quenching takes place within each furnace, in successive steps, providing for close operating control.

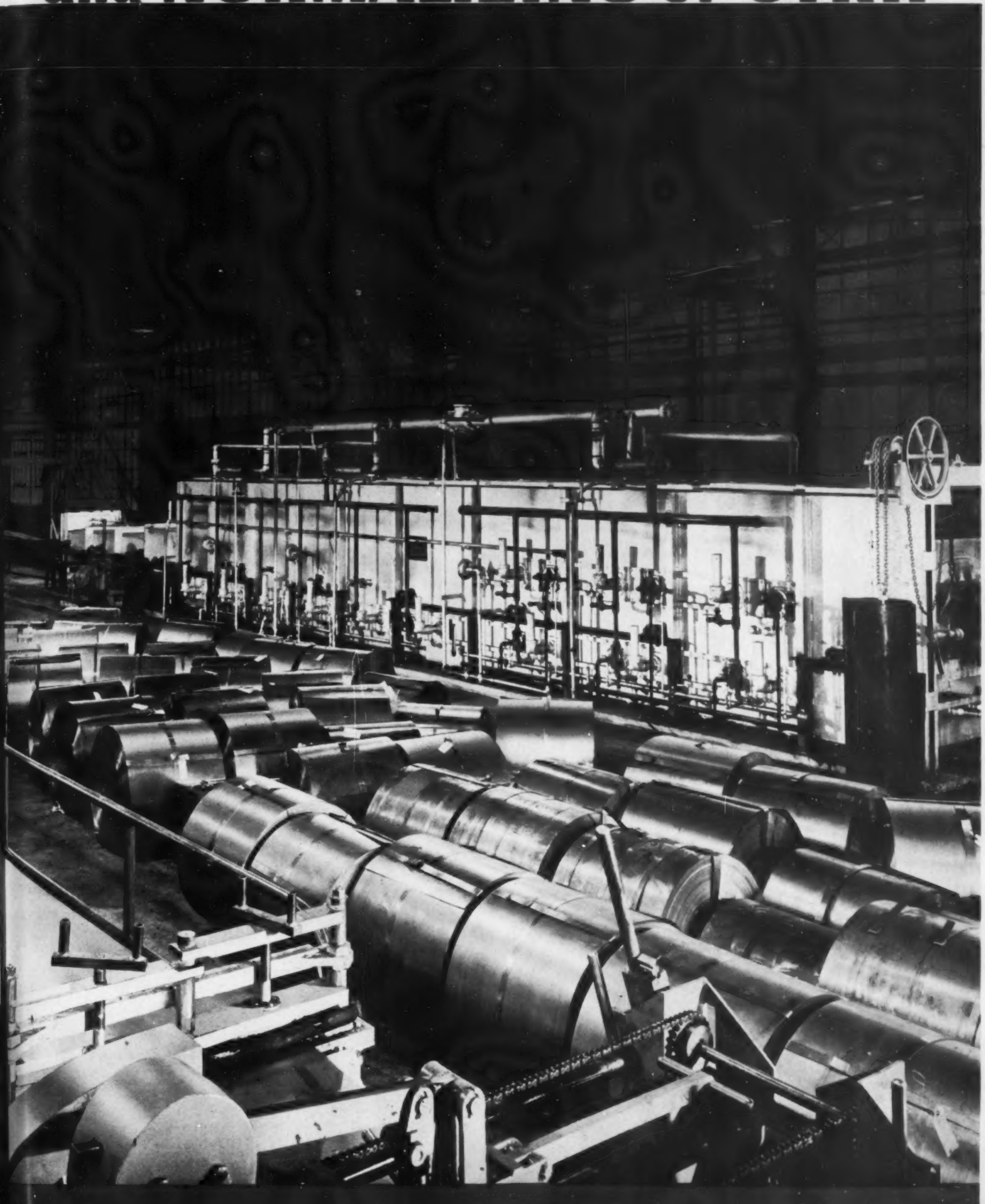
Whatever the production requirement—continuous or batch operation, "Surface" has many modern developments including the Radiant Tube and a broad background of research in the Science of Gas Chemistry and Heat Treating, to apply to the engineering of advanced heating and heat treating equipment for the specific job. With improved handling mechanisms, all these combined scientific tools have resulted in closer metallurgical control . . . greater capacities, and increased tonnage.

Wherever heat is used—from the ingot to finished product, it pays to consult "Surface" Engineers about modern methods and equipment.

**'Surface'**

**SURFACE COMBUSTION**
**TOLEDO 1, OHIO**

# and NORMALIZING of STRIP



SPEER'S
Perfect
Matching
Burning
Sparking
Overheating
Excess Wear
Energy Loss
CANCELLED
SPEER

**STAMPS OUT lots of brush troubles**

SPEER *matches* brushes — mechanically and electrically — to individual machines. So for really *first class* performance from *any* commutating equipment, it pays to call on SPEER. From its all-inclusive line of standard and special carbon, graphite, electro-graphite, and metal-graphite grades, SPEER can supply the brushes that will deliver peak performance in *your* equipment—with fewest brush renewals, and least maintenance.

Why tolerate such brush troubles as burning, sparking, overheating, and excessive wear and energy losses from "misfit" brushes? Why be satisfied with less than a perfect match of brushes to machines — when you can take advantage of SPEER'S nearly 50 years' specialization in helping motor users and designers to obtain the right brush grade for individual machines! Write for Brush Data Forms today.

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CARBON COMPANY
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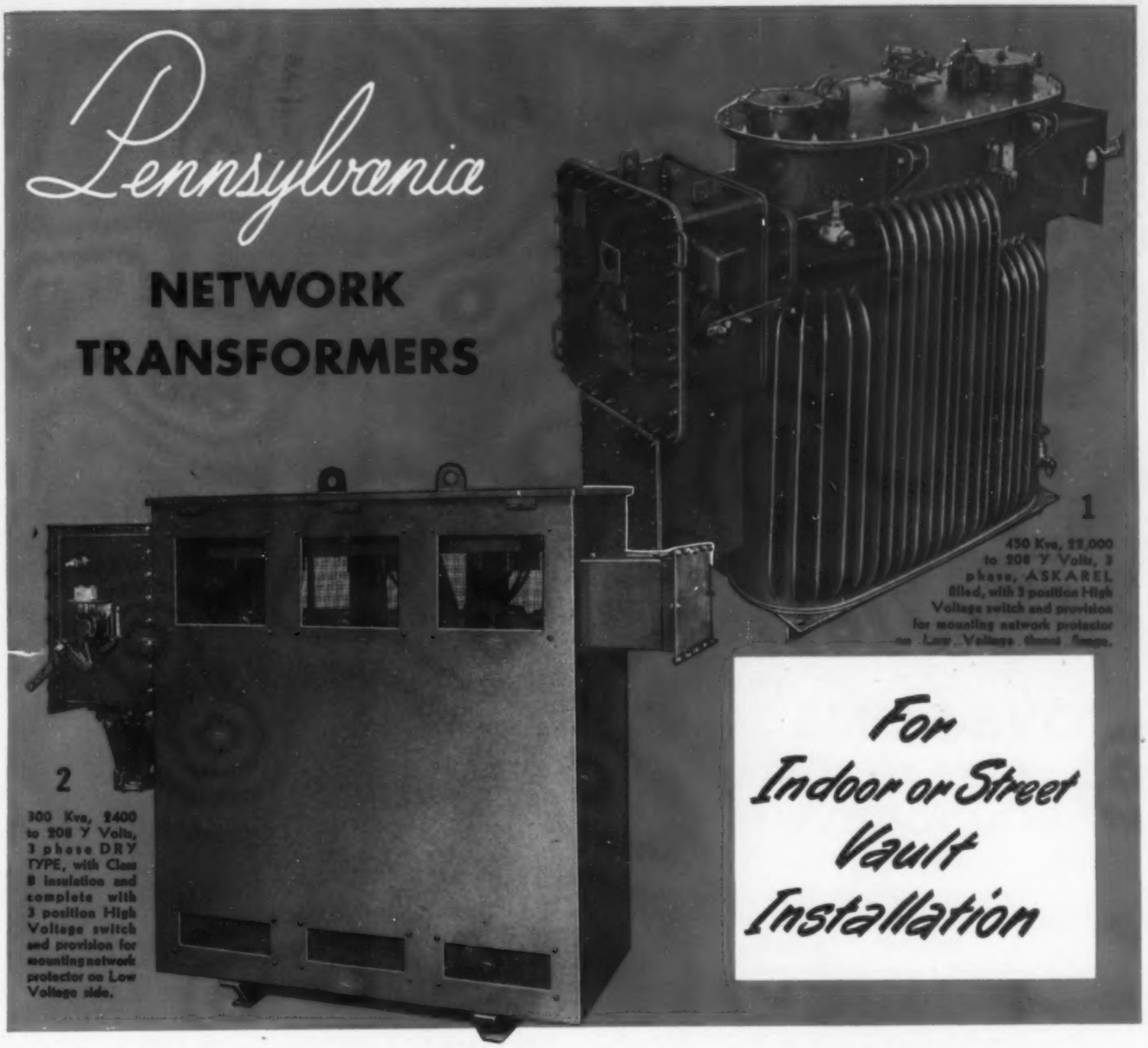


*Pennsylvania*

**NETWORK TRANSFORMERS**

1

450 Kva, 22,000 to 208 Y Volts, 3 phase, ASKAREL filled, with 3 position High Voltage switch and provision for mounting network protector on Low Voltage throat flange.

2

300 Kva, 2400 to 208 Y Volts, 3 phase DRY TYPE, with Class B insulation and complete with 3 position High Voltage switch and provision for mounting network protector on Low Voltage side.

*For Indoor or Street Vault Installation*

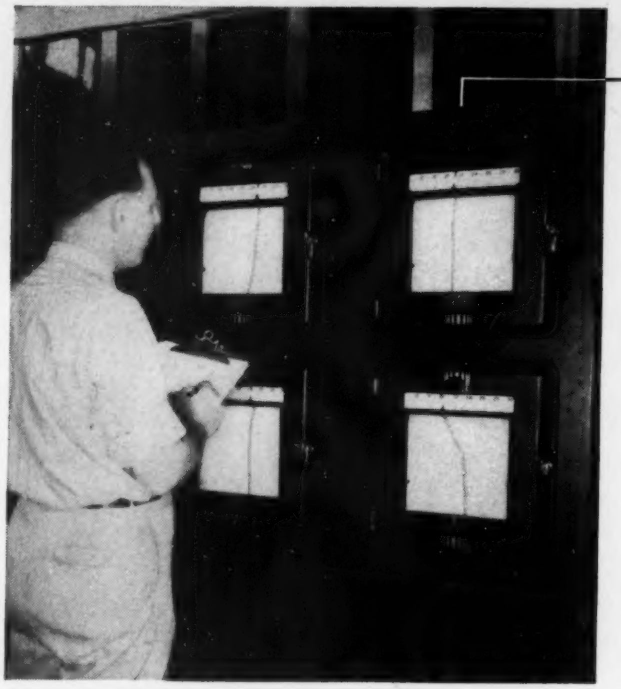
Illustrated are two types of ***Network Transformers*** Pennsylvania Transformer Company has developed to meet the demand of high density loads in congested areas.

Photo No. 1 shows the ASKAREL filled type intended primarily for street vault installation. Because its coolant—ASKAREL—is non-inflammable and non-explosive, it may also be installed in buildings without violation of the National Safety Code.

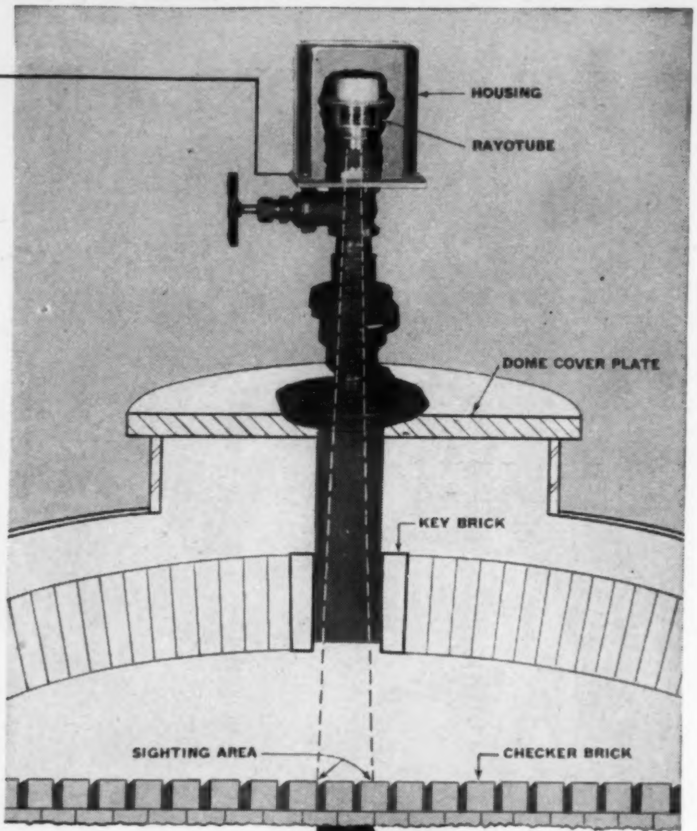
Photo No. 2 shows a dry type unit built for installation indoors near the load center in industrial plant applications or in buildings in utility network applications. Its liquid-free, fireproof construction permits it to be mounted with safety above or near the working area of industrial plants, or on upper floors of buildings in a vertical network. An additional safety feature is provided in the method of interlocking the hinged cover with the high voltage switch and network protector, which prevents access to the terminal board when the transformer is energized. With no valves, gaskets or gauges to service, maintenance is low. And because vaults or special housings are not required, installation time and expense are greatly reduced.

Pennsylvania Transformer Company also builds a complete line of power and distribution transformers to meet every industrial or domestic service requirement.

*Pennsylvania* TRANSFORMER COMPANY
808 Ridge Avenue, N. S., Pittsburgh 12, Pa.

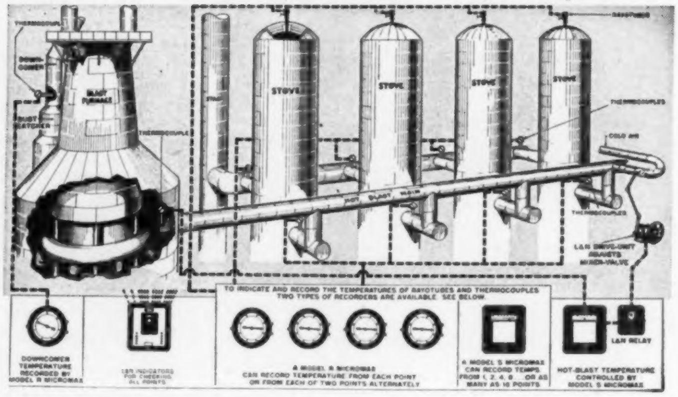


This comparatively new way of measuring stove temperatures is a definite help to higher efficiency. Above photo is not in a steel mill, but does show one of the popular types of Micromax Recorder for steel mill service.


HOUSING
RAYOTUBE
DOME COVER PLATE
KEY BRICK
SIGHTING AREA
CHECKER BRICK

# STOVE-DOME TEMPERATURES

## ARE EASIER TO CONTROL IN THIS RAYOTUBE WAY


THERMOCOUPLE
DOWN-COMER
BLAST FURNACE
DUST CATCHER
THERMOCOUPLE
STACK
STOVE
STOVE
STOVE
STOVE
RAYOTUBES
THERMOCOUPLES
COLD AIR
HOT BLAST MAIN
THERMOCOUPLES
L&N DRIVE-UNIT ADJUSTS MIXER-VALVE
TO INDICATE AND RECORD THE TEMPERATURES OF RAYOTUBES AND THERMOCOUPLES TWO TYPES OF RECORDERS ARE AVAILABLE. SEE BELOW.
DOWNCOMER TEMPERATURE RECORDED BY MODEL R MICROMAX
L&N INDICATORS FOR CHECKING ALL POINTS
A MODEL R MICROMAX CAN RECORD TEMPERATURE FROM EACH POINT OR FROM EACH OF TWO POINTS ALTERNATELY
A MODEL S MICROMAX CAN RECORD TEMPS. FROM 1, 2, 4, 6 .... OR AS MANY AS 16 POINTS
L&N RELAY
HOT-BLAST TEMPERATURE CONTROLLED BY MODEL S MICROMAX

Several dozen sets of blast-furnace stoves are now being temperature-controlled by means of Micromax Pyrometers with Rayotubes, instead of thermocouples, as their temperature-detecting units. Rayotubes, in the mounting designed especially for stove domes, have various advantages:

1. It's definitely easier to operate the stoves at full efficiency. When thermocouples are used as detectors, the temperature recorded is that of the blast gas. Rayotubes, however, give the temperature of the checker-brick surfaces, and it is of course this temperature which governs the stove's operation. Guided by brick temperature, the operators can prevent fusing of ash and damage to checkers, yet can run the stoves safely at maximum heat capacity.

2. Maintenance of Rayotubes is only a small fraction of that required by thermocouples, because Rayotubes should never burn out. The hot, corrosive blast gas does not reach the temperature-sensitive element, and only normal routine care is required, both for Rayotube and Micromax Recorder.

Catalog N-33B describes Micromax Rayotube Pyrometers in general, and will be sent on request. If you have a specific problem, an L&N engineer will be glad to send or bring more specific information.

LEEDS & NORTHRUP COMPANY, 4942 STENTON AVE., PHILA. 44, PA.

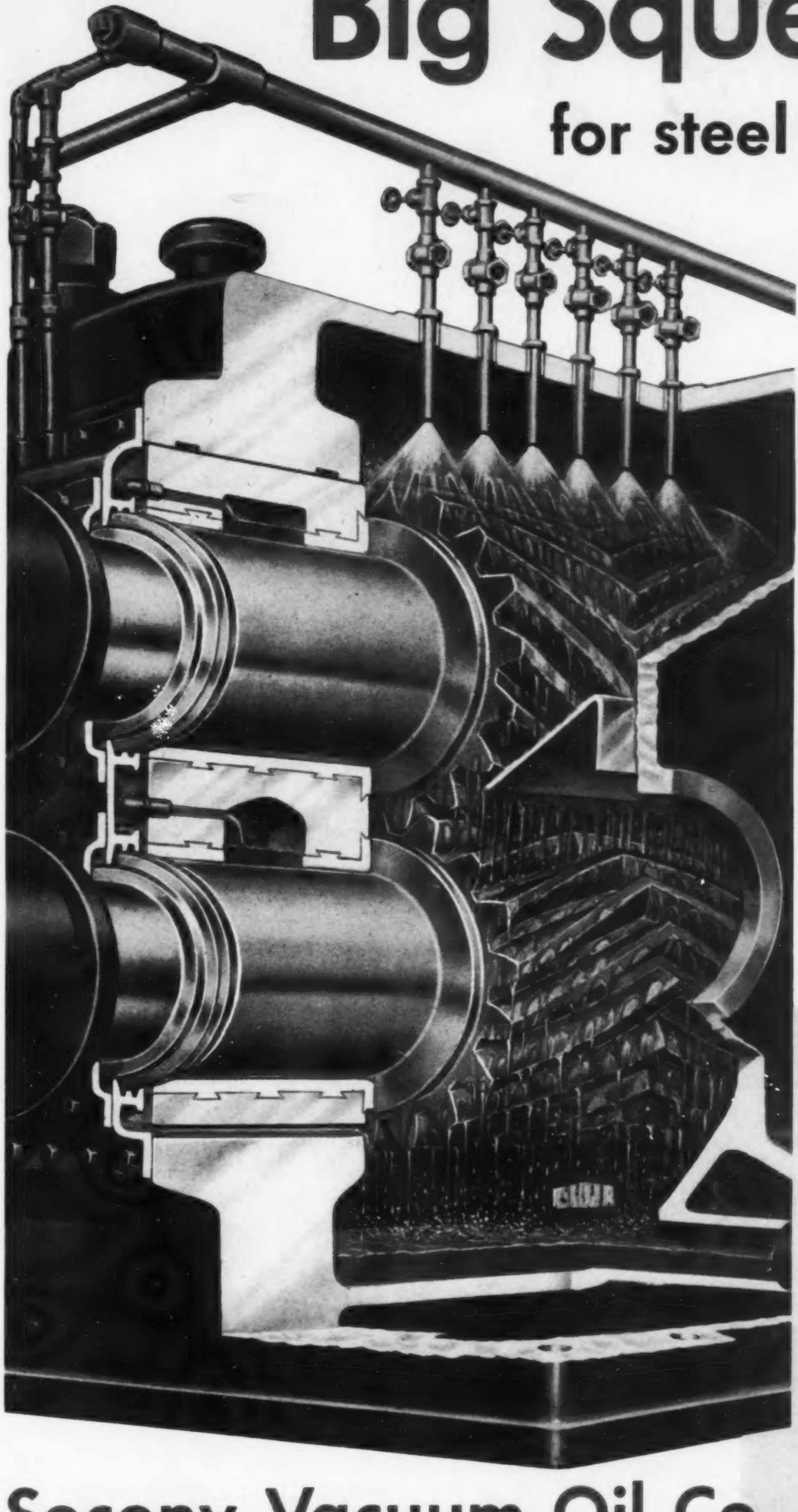
**LEEDS & NORTHRUP**

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

Jrl Ad N-33B-642(2)

# Big Squeeze

## for steel and oil, too!



IN THIS PINION stand, the tremendous pressures that squeeze massive ingots of steel into sheets or structural shapes, are actually transmitted through microscopic films of oil. Clinging to the meshing teeth, these films must resist rupture and prevent metal-to-metal contact, excessive friction, heat and wear.

To stand up under such exceptional conditions, "Prescription Lubricants" are required — Gargoyle Compounds. These Compounds form tough, tenacious films that will not be "squeezed out" or ruptured by the terrific pressures encountered in enclosed high-duty gears. Their rich lubricating qualities minimize wear and friction losses. Equally important in circulation systems, they resist deterioration in continuous use and assure low oil consumption.

For greatest protection . . . for longer gear life . . . for low maintenance costs, put Gargoyle Compounds in your pinion stands.

**Get this Complete Lubrication Program for all your machines**

- **Lubrication Study of Your Entire Plant**
- **Recommendations to Improve Lubrication**
- **Lubrication Schedules and Controls**
- **Skilled Engineering Counsel**
- **Progress Reports of Benefits Obtained**

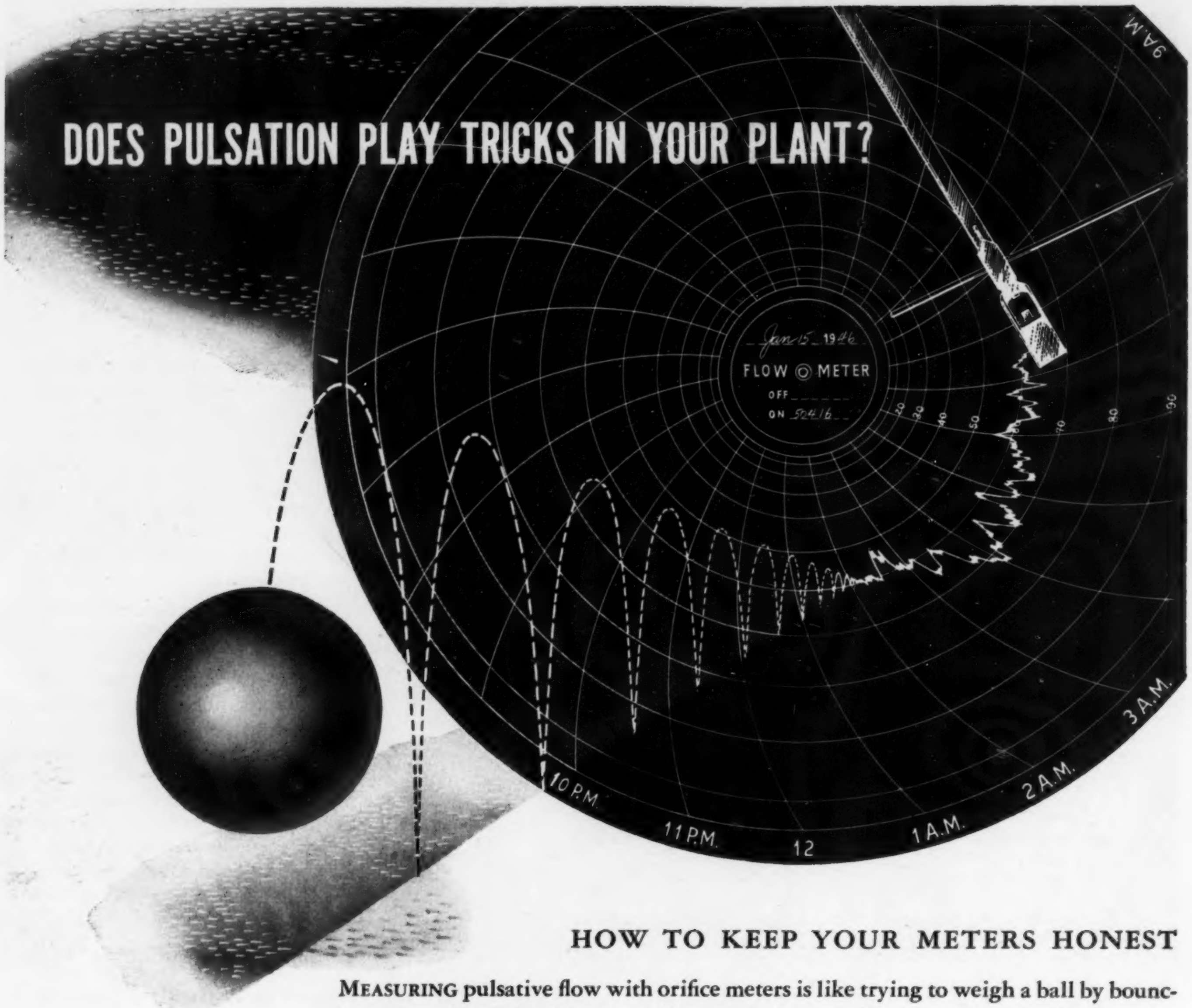
GARGOYLE
Lubricants

# Socony-Vacuum Oil Co., Inc.

**and Affiliates: Magnolia Petroleum Co. · General Petroleum Corp. of Calif.**

**TUNE IN "INFORMATION PLEASE"—MONDAY EVENINGS—9:30 E.S.T.—NBC**

# DOES PULSATION PLAY TRICKS IN YOUR PLANT?



## HOW TO KEEP YOUR METERS HONEST

MEASURING pulsative flow with orifice meters is like trying to weigh a ball by bouncing it on the scales. Downward-upward thrusts give inaccurate readings... they happen so fast the measuring instrument can't keep up with them. To keep your orifice meters honest, pulsative flow must be converted into a steady stream. The FLUOR Pulsation Dampener is the practical answer to this problem.

For example—a large Eastern Gas Company pumps gas into underground storage during the summer and withdraws it during the winter when consumer load is heaviest. As storage reservoir pressure drops, it becomes necessary to compress the gas to maintain pressure in the mains. Pulsations set up in the gas stream by the compressors threw the meters off by such substantial amounts that the Company was unable to determine how much gas was being pulled out of the reservoir. FLUOR Pulsation Dampeners installed in the suction lines between the meters and compressors eliminated this condition and made accurate measurement possible.

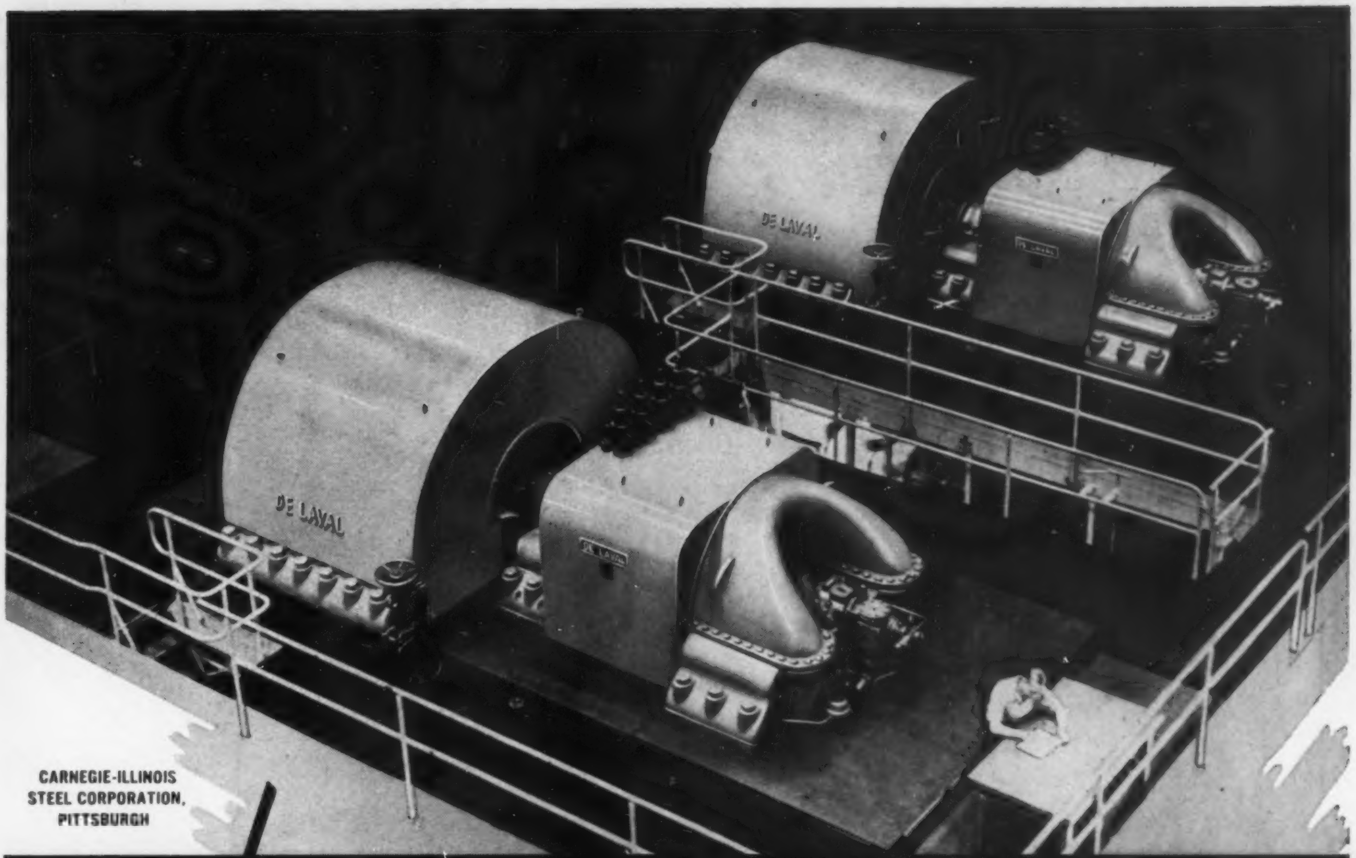
The FLUOR Pulsation Dampener changes pulsative flow into smooth, steady flow... with beneficial effect on frictional losses, horsepower savings and rate of flow. If vibration plays *tricks* in *your* plant, it may be due to pulsations in air, gas or vapor lines. In that case, the FLUOR Pulsation Dampener is your answer.

fc
SINCE
1890

**FLUOR** PULSATION DAMPENER

THE FLUOR CORPORATION, LTD. 2500 South Atlantic Boulevard, Los Angeles 22
NEW YORK • PITTSBURGH • KANSAS CITY • HOUSTON • TULSA • BOSTON

ENGINEERS • MANUFACTURERS • CONSTRUCTORS


CARNEGIE-ILLINOIS
STEEL CORPORATION,
PITTSBURGH

# WORLD'S RECORD *BROKEN AGAIN!*

## *by* FURNACE EQUIPPED WITH DE LAVAL BLOWERS

For the second time in two years, the world's record has been broken for pig iron production from a single furnace served with De Laval turbine-driven blast furnace blowers.

During the month of July, 1945 the No. 2 Furnace of the Edgar Thompson Works of the Carnegie-Illinois Steel Corp. produced a record-breaking 50,590 tons.

The De Laval blowers at the Edgar Thompson Works, with a capacity of 97,800 c.f.m. against 30 p.s.i., were designed for the highest maximum steam pressure (700 p.s.i) and temperature (825 F.) ever used for this service.

**CONSULT THE DE LAVAL STEAM TURBINE CO. FOR CENTRIFUGAL BLOWERS AND COMPRESSORS OF ADVANCED DESIGN.**

3833

TURBINES • HELICAL GEARS
WORM GEAR SPEED REDUCERS
CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS and COMPRESSORS • IMO OIL PUMPS

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STEAM TURBINE COMPANY · TRENTON 2, NEW JERSEY

SALES OFFICES ATLANTA • BOSTON • CHARLOTTE • CHICAGO • CLEVELAND • DENVER
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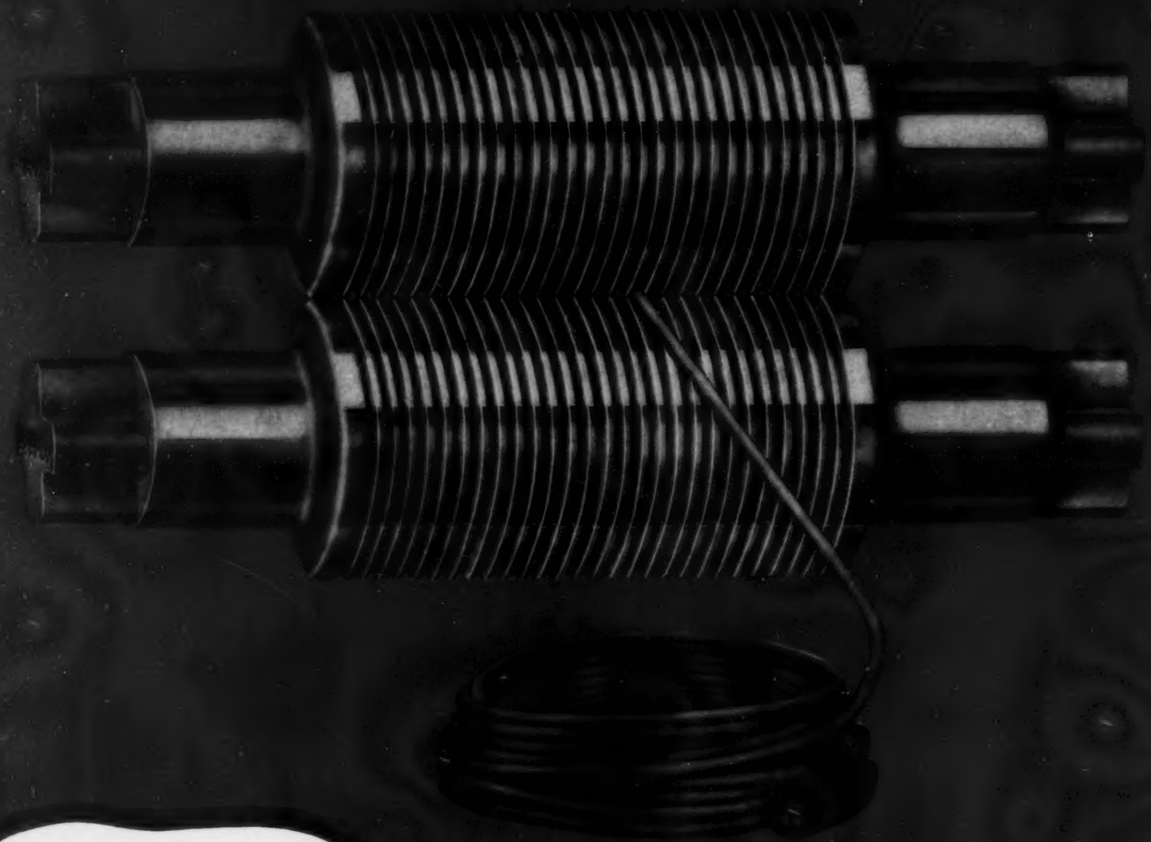
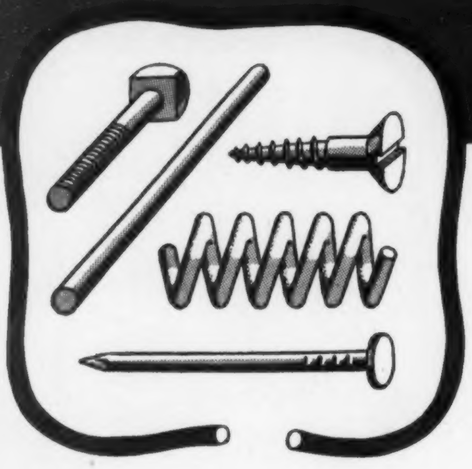
And Cities in Central and South America

ROLLING TECHNIQUE . . .





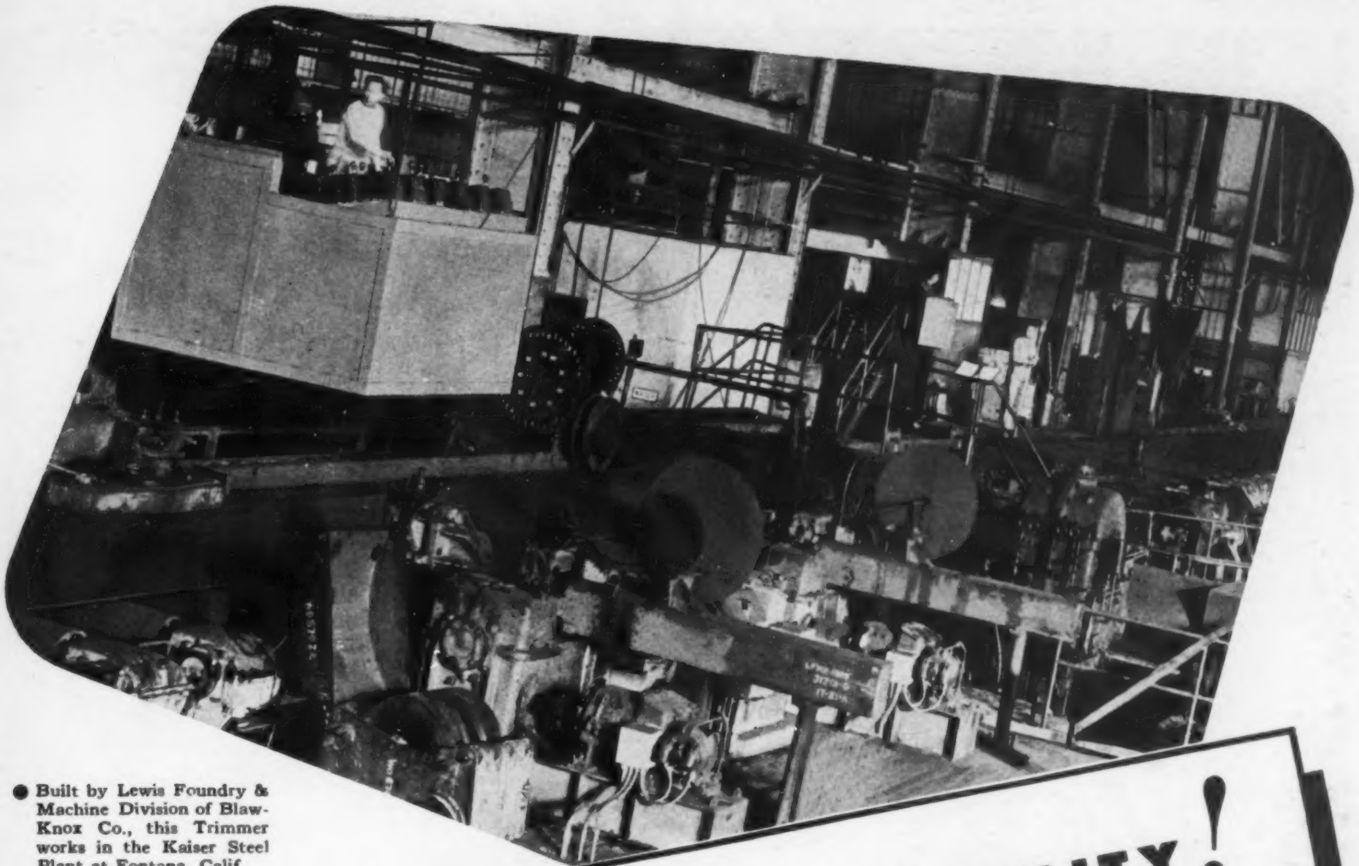
# *Rods*

Rod mills, with their ever increasing delivery speeds, require better and better rolls to stand up and give high tonnages of quality rod. Continuous rod mills now in operation are rolling not only steel and numerous alloys but non-ferrous metals as well.

Pittsburgh Rolls, with over three-quarters of a century of roll-making experience and satisfactory performance behind them, can be relied upon to deliver the production of highest quality for which high speed modern mills are designed, at *less cost per ton of steel rolled.*

**PITTSBURGH ROLLS**
**Division of Blaw-Knox Company**
**PITTSBURGH, PA.**

**PITTSBURGH ROLLS**



● Built by Lewis Foundry & Machine Division of Blaw-Knox Co., this Trimmer works in the Kaiser Steel Plant at Fontana, Calif.

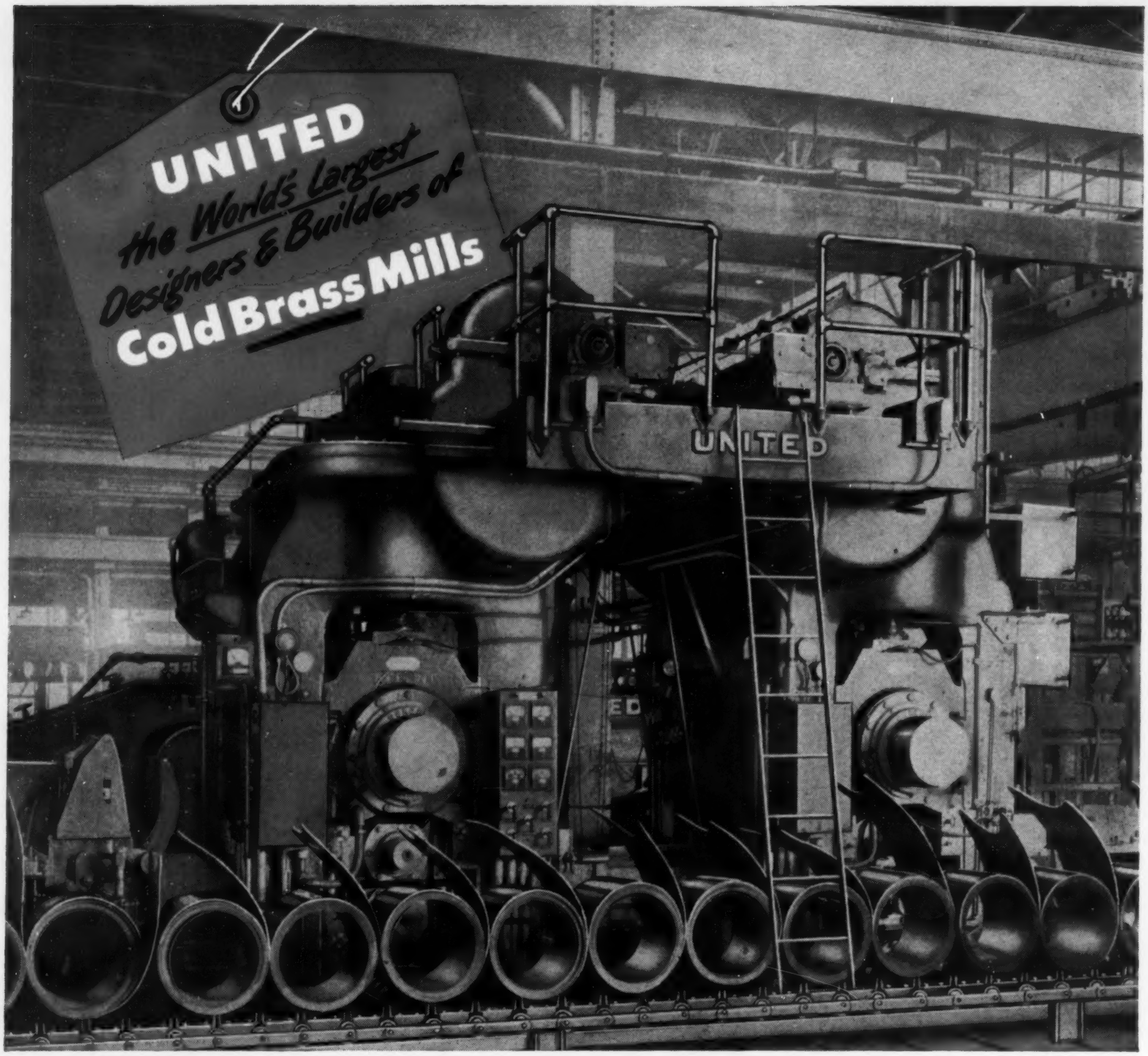
FOR *Trimmer* RELIABILITY!

SKF Spherical Roller Bearings, with their rolling alignment, assure equalized load distribution that means full capacity for useful work. They require a minimum of lubrication and never need adjustments. On this 110″ Rotary Side Trimmer, this permits accurate adjustment of the overhung knives . . . freedom from bearing trouble . . . low maintenance. For further information, refer to our catalog, 'Steel Mill Data for Calculation and Design,' or write direct.

5986

SKF INDUSTRIES, INC., PHILA. 34, PA.

SKF
Puts the
RIGHT BEARING
in the
RIGHT PLACE



*In Use the World Over*

UE&FCO
REG. T. M.

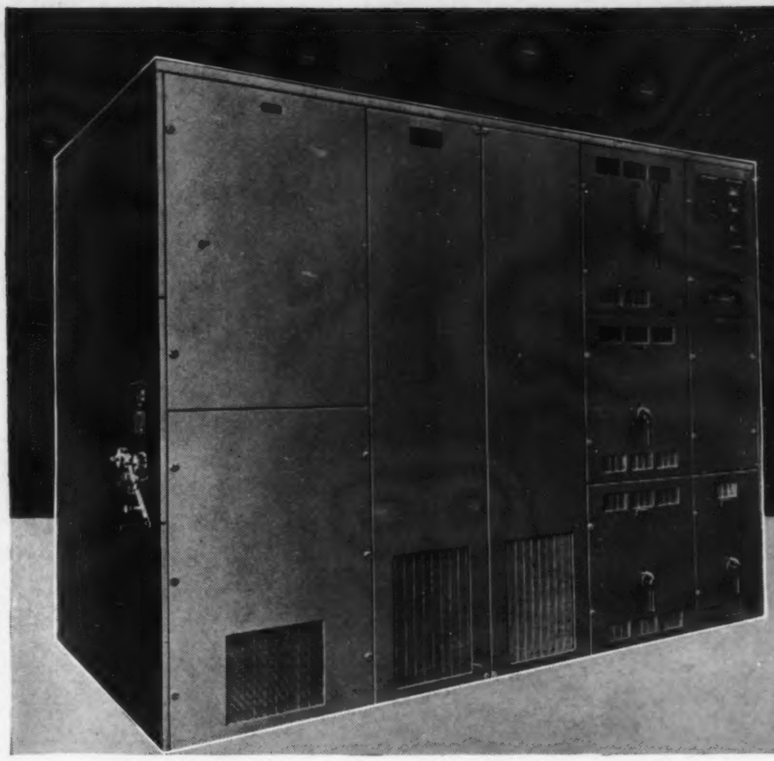
Intimate knowledge of non-ferrous rolling requirements, born of long and close cooperation with the industry, has enabled UNITED to maintain consistent leadership in the design and construction of all types of mills and related equipment for the rolling of brass, copper and other non-ferrous metals.

The 36"—4 High, 2 Stand Tandem Cold Brass Mill illustrated, is a late model, heavy duty, precision unit complete with patented coil handling equipment. It rolls an extremely accurate product from edge to edge and from end to end at high production speeds.

Designs for this mill, and for other recent installations, are available for duplication or modification. UNITED'S engineers are prepared to create entirely new designs for special or unusual operational or product requirements.

**Plants at PITTSBURGH · VANDERGRIFT · NEW CASTLE · YOUNGSTOWN · CANTON**
*Subsidiary:* Adamson United Company, Akron, Ohio
*Affiliates:* Davy and United Engineering Company, Ltd., Sheffield, England
Dominion Engineering Works, Ltd., Montreal, P.Q., Canada
**The World's Largest Designers and Makers of Rolls and Rolling Mill Equipment*

**UNITED ENGINEERING**
**AND FOUNDRY COMPANY**
PITTSBURGH, PENNSYLVANIA



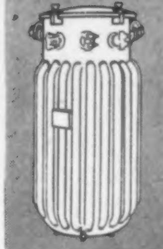
# *Specify* Wagner Unit Substations!

One order to Wagner brings everything needed to meet your exact transformer and switchgear needs—a complete unit substation engineered as a single unit, fully backed with undivided responsibility by Wagner.

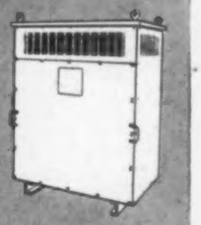
Wagner unit substations are easy to install—and when future load changes so dictate, easy to move intact to a new location.

In addition to (1) ease of ordering, (2) undivided responsibility, (3) simplicity of installation and (4) ease of relocation, Wagner unit substations offer you such other important advantages as (5) less installation expense, (6) maintenance is simplified, (7) low-voltage feeders are shortened, (8) less manpower needed to make changes, (9) built of the highest-quality materials in accordance with the latest engineering practices.

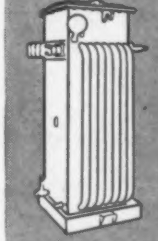
Get acquainted with entire Wagner line of distribution and power transformers. Ask for Bulletins TU-180 and TU-181, gladly sent on request addressed to Wagner Electric Corporation, 6483 Plymouth Avenue, St. Louis 14, Mo.



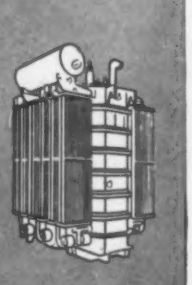
**Distribution Transformers**



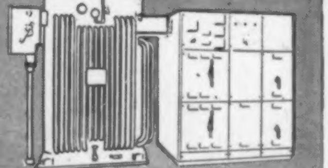
**Air-Cooled Transformers**



**Noflamol Transformers**



**Power Transformers**



**Unit Substations**

***Other Wagner Products for Industry:* Air Brakes • Brake Lining • Electric Motors • Hydraulic Brakes • Industrial Braking Systems • NoRoL • Tachograph**

***Consult Wagner Engineers on all Transformer Problems***

**Wagner**

T46-3

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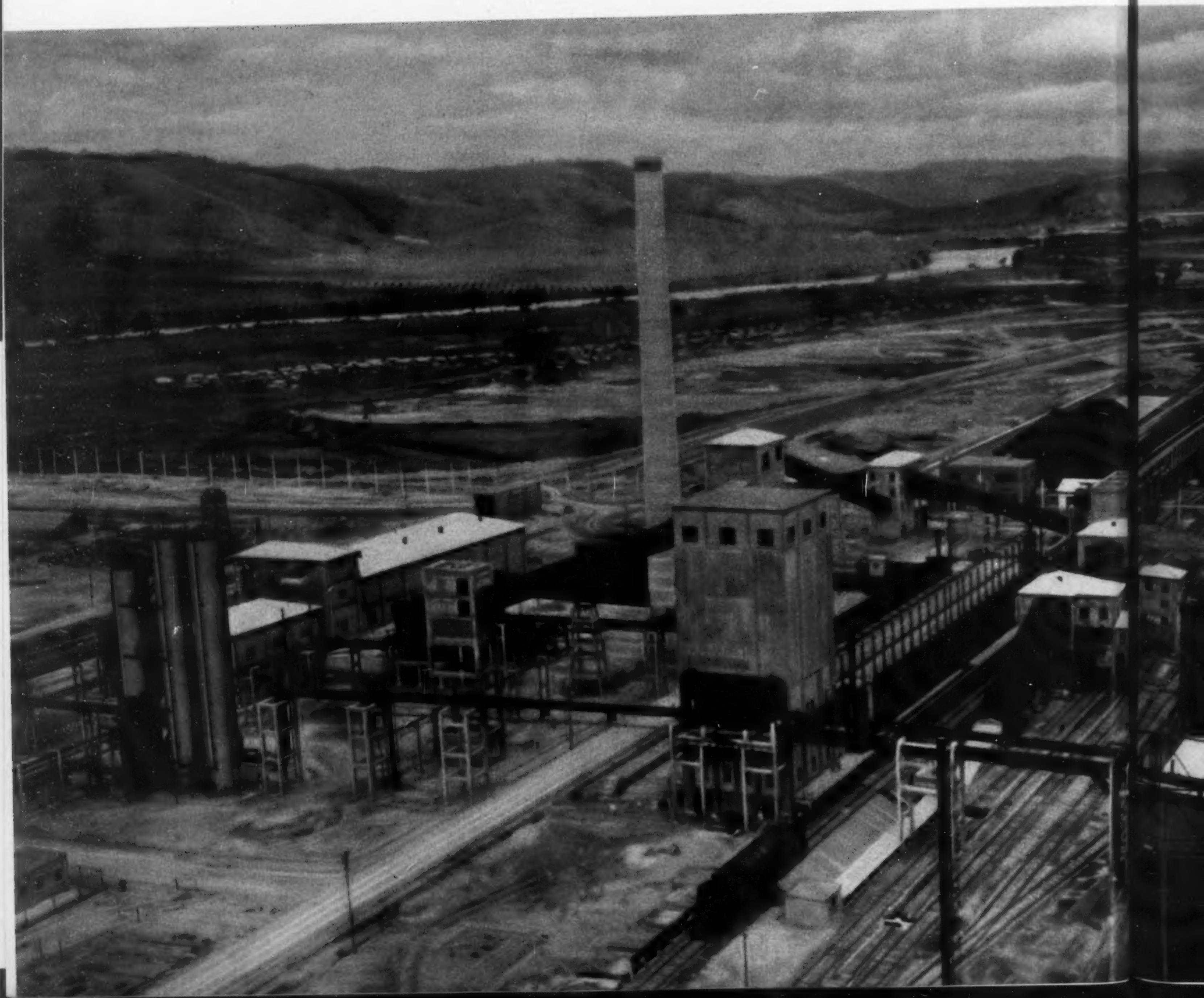
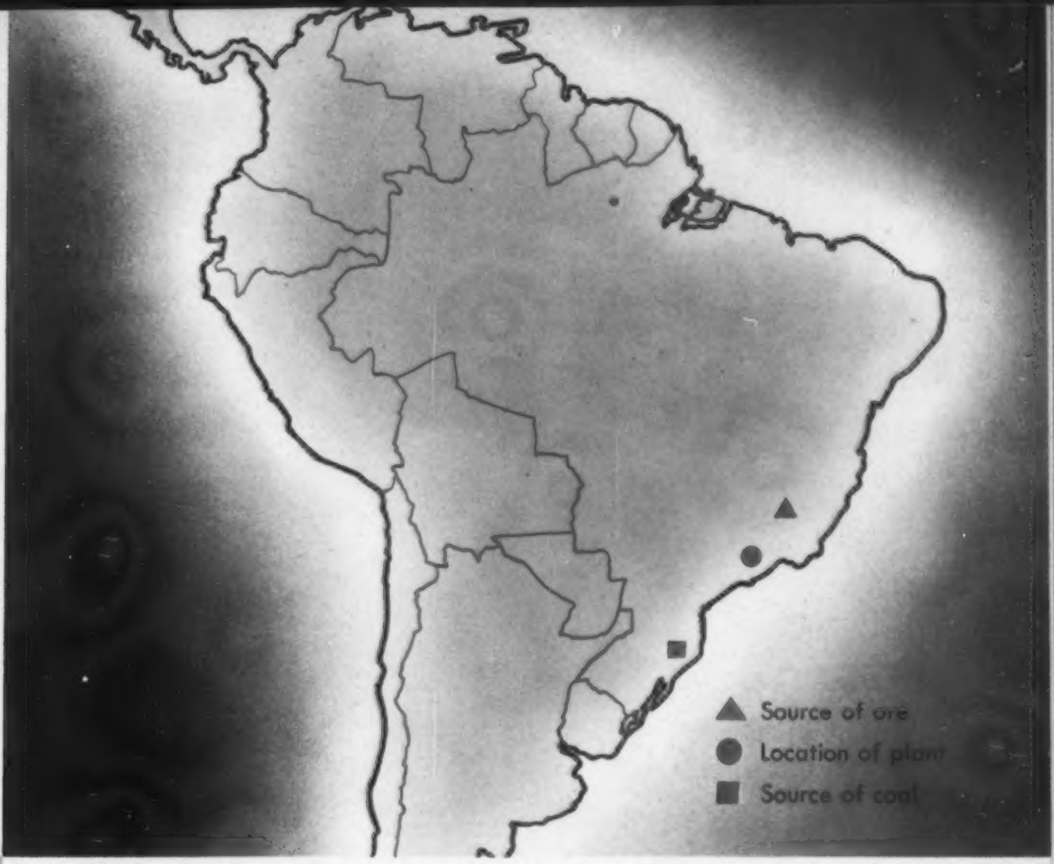
SAN FRANCISCO 3 • SEATTLE 4 • SYRACUSE 2 • TULSA 3 • WASHINGTON 5
*In Canada:* WAGNER ELECTRIC AT LEASIDE, ONTARIO

# *Will this plant open a "new" marketor s*



# ket for steel?



**Koppers-Becker Underjet Coke-Ovens with Waste-Gas Recirculation and Koppers Byproduct Plant at Volta Redonda, Brazil.**

This is the coke-oven plant of the Brazilian National Steel Corporation at Volta Redonda.

Brazil is a nation of 44,000,000 people. It occupies almost half the land area of South America. Yet it consumes only 350,000 metric tons of steel a year, which is less than the city of St. Louis uses a year.

This plant will make it possible for South Americans to use more steel. If they get into the habit of using more steel, they can create a tremendous market far beyond the capacity of South American plants to fill.

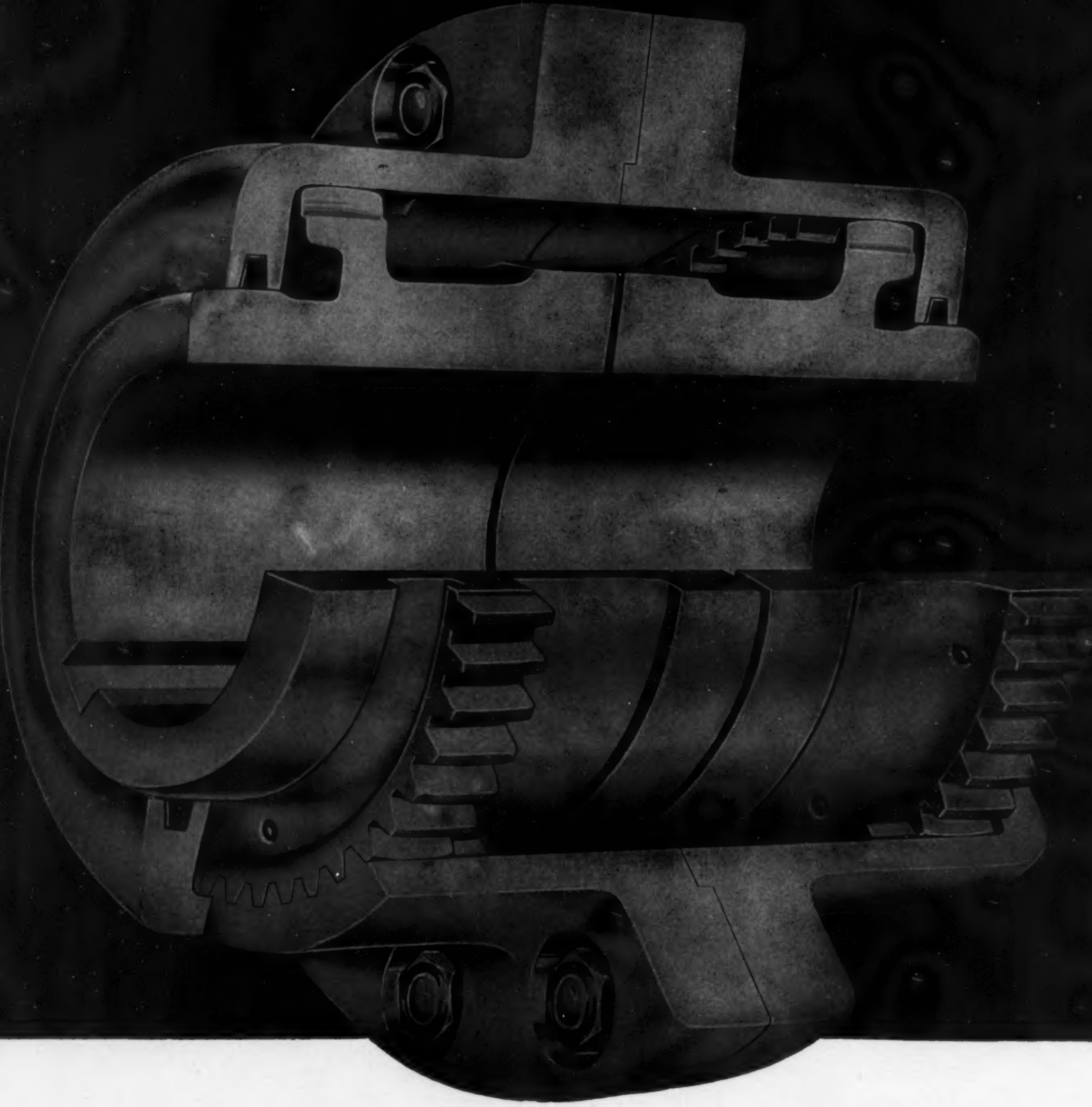
This coke-oven plant contains 55 Koppers-Becker Underjet Ovens with Waste-Gas Recirculation, as well as a complete byproduct plant, three Koppers-Kerpely Gas Producers and a tar-distillation plant. The coke-oven plant has the capacity to carbonize 570,000 tons of coal a year, and the tar plant can process 5,480,000 United States gallons of tar per year.

**KOPPERS**

THE INDUSTRY THAT SERVES ALL INDUSTRY

KOPPERS COMPANY, INC., **ENGINEERING AND CONSTRUCTION DIVISION,** PITTSBURGH 19, PA.

# POOLE



A COPY OF CATALOG GIVING FULL DESCRIPTION AND ENGINEERING DATA SENT UPON REQUEST.

# FLEXIBLE COUPLINGS

POOLE FOUNDRY & MACHINE COMPANY

WOODBERRY, BALTIMORE, MD.

**The IRON and STEEL INDUSTRY is planning to spend more than a**

# Half Billion Dollars

**for reconversion and repairs**

**If you want a share of this business, here is a sales promotion suggestion . . .** →

## EXHIBIT YOUR PRODUCTS in

# the 1946 Iron an

They come to see, to ask questions and to BUY!

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These serious operating and engineering executives eagerly watch well-planned demonstrations and carefully examine exhibits and samples of products.

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1010 EMPIRE BUILDING

# n Steel Exposition

## LEVELAND PUBLIC AUDITORIUM
## OCTOBER 1-2-3-4, 1946

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planned
nine ex-

For the first time in five years—here is your chance to show your new and improved products to operating and engineering executives of the iron and steel industry *in person!* They are coming to Cleveland in October especially to see and hear about new developments and products they can use.

It will be the 42nd convention and IRON AND STEEL EXPOSITION—and the first time in five years you have had an opportunity to show your wares to this important and interested audience. They are hungry for information on product developments that help them make or fabricate metal better or easier or at less cost. You can expect a good, representative audience, for Cleveland is close to home for most steel makers. Within a 350 mile radius are 340 major steel plants having 93 per cent of the nation's ingot capacity.

Better reserve your space *now* so that you will be assured of the location you want, and to allow ample time to plan and to build your exhibit. Write for details.

**dvertising tie-in heightens the effect**

Iron & Steel Daily News

ANNUAL CONVENTION AT CLEVELAND IN 1946 TO INCLUDE EXPOSITION

Iron and Steel ENGINEER

MESTA

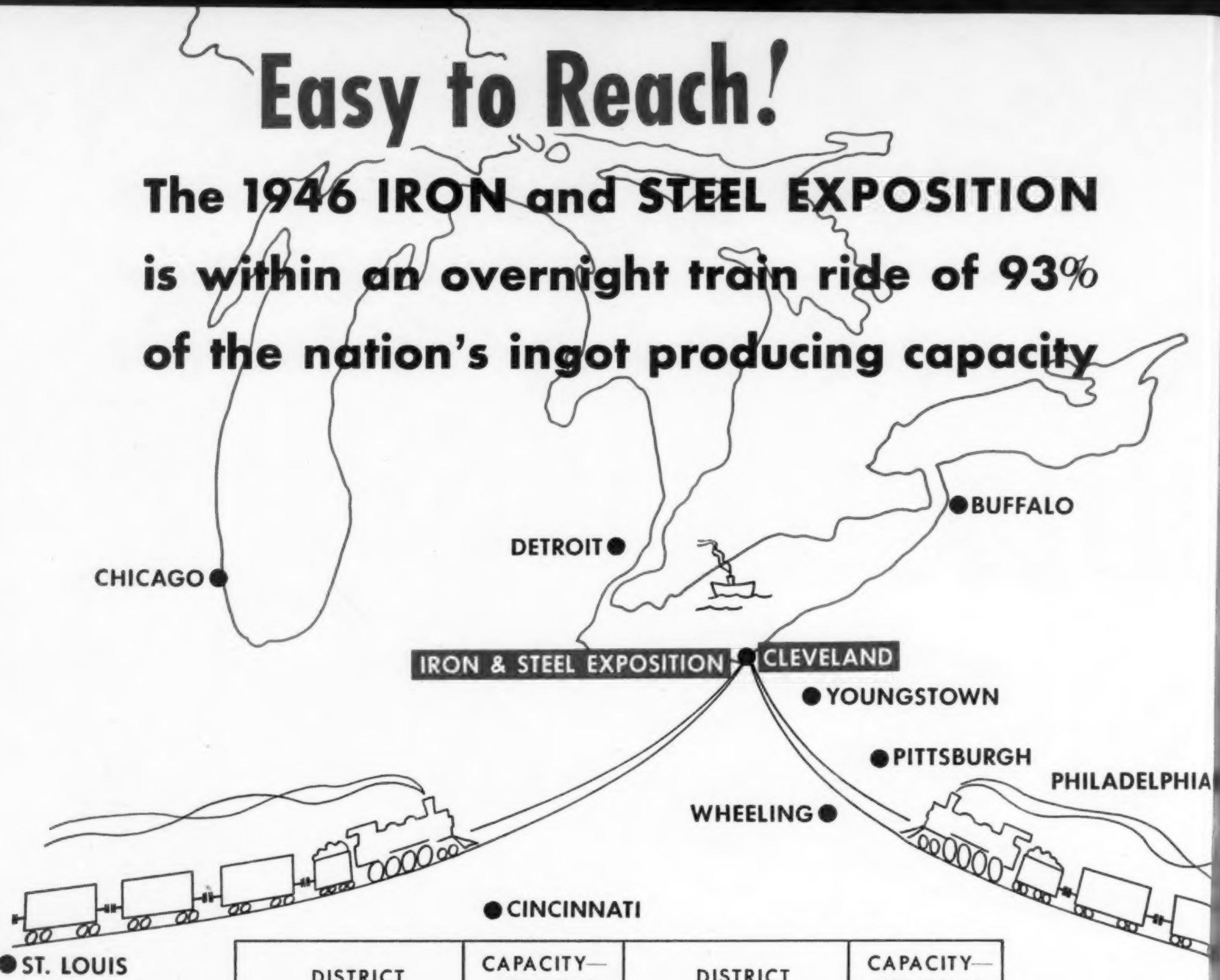
Your advertising in IRON AND STEEL ENGINEER and the Iron and Steel Daily News multiplies the value of your exhibit.

## RON AND STEEL ENGINEERS

PITTSBURGH 22, PA.

# Easy to Reach!

## The 1946 IRON and STEEL EXPOSITION is within an overnight train ride of 93% of the nation's ingot producing capacity


BUFFALO
DETROIT
CHICAGO
IRON & STEEL EXPOSITION
CLEVELAND
YOUNGSTOWN
PITTSBURGH
PHILADELPHIA
WHEELING
CINCINNATI
ST. LOUIS

| DISTRICT | CAPACITY—NET TONS | DISTRICT | CAPACITY—NET TONS |
|---|---|---|---|
| Pittsburgh | 22,521,000 | Wheeling | 3,320,000 |
| Chicago | 18,932,000 | Detroit | 3,190,000 |
| Youngstown | 13,208,000 | Cincinnati | 2,760,000 |
| Philadelphia | 10,784,000 | St. Louis | 1,758,000 |
| Cleveland | 4,541,000 | Eastern | 879,000 |
| Buffalo | 4,443,000 | | |

**Put your products where they will be seen by important operating executives—the**

## 42nd IRON and STEEL EXPOSITION . . . . . .

## Cleveland October 1-2-3-4, 1946

***For Reservations WRITE, WIRE or PHONE ASSOCIATION OF IRON AND STEEL ENGINEERS***

1010 EMPIRE BUILDING • PITTSBURGH 22, PA.

# Let's Look at SALEM'S RECORD on Continuous Buttweld Pipe Mills

Efficient metal recuperators . . . another "S" contribution to high operating efficiency and lower maintenance costs.

When you invest your company dollars in a major expenditure like Continuous Buttweld Pipe Mills, you want the benefit of men who know *all* the answers.

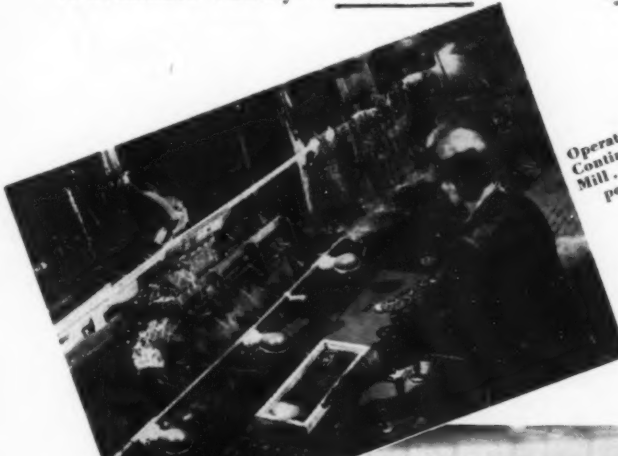
**Salem knows the pipe business from all angles . . . equipment, manufacturing, and markets.**
**We should.**

***Salem has engineered, built, or furnished equipment for every continuous buttweld pipe mill installed in the United States and Canada.***

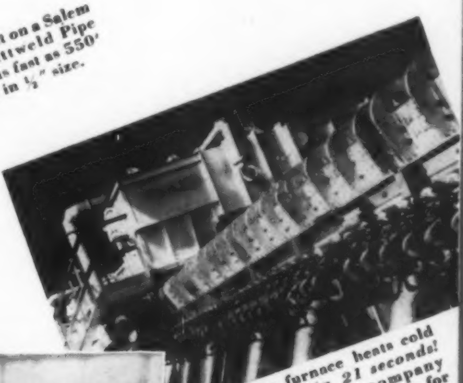
**Experience on the following installations comprising all of the continuous buttweld pipe mills in U. S. and Canada is available when you Call Salem.**

*Etna, Pa.* . . . Two furnaces by Salem.
*Welland, Ont.* . . Complete installation by Salem.
*Youngstown, O.* Complete installation by Salem.
*Youngstown, O.* . . Furnace by Salem.
*Youngstown, O.* . . Furnace by Salem.
*Sparrows Pt.* Two complete installations by Salem.
*Indian Harbor* . . Complete equipment by Salem.
*Benwood* . . . . Complete installation and equipment by Salem.

***These mills produce 1,000,000 tons of quality pipe per year.***



Operator's pulpit on a Salem Continuous Buttweld Pipe Mill . . speeds as fast as 550' per minute in ½" size.



This Salem furnace heats cold skelp to 2250 in 21 seconds! Salem is the only company which has built a furnace for continuous buttweld pipe mills.

The original single loop has been improved by a double loop. Saves space and improves operating efficiency. The patented Salem double loop eliminates time-consuming difficulties.

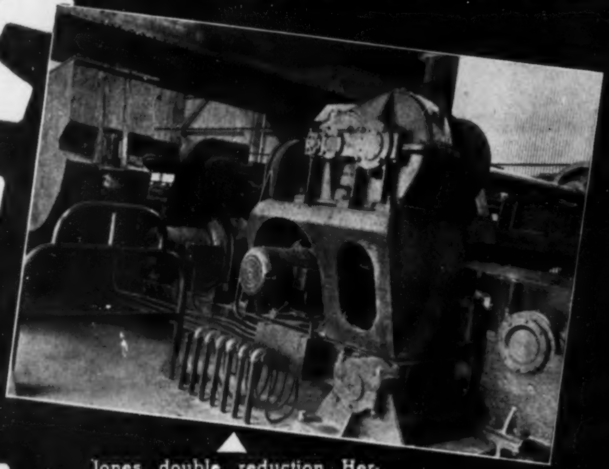
SALEM

## SALEM ENGINEERING CO. SALEM OHIO

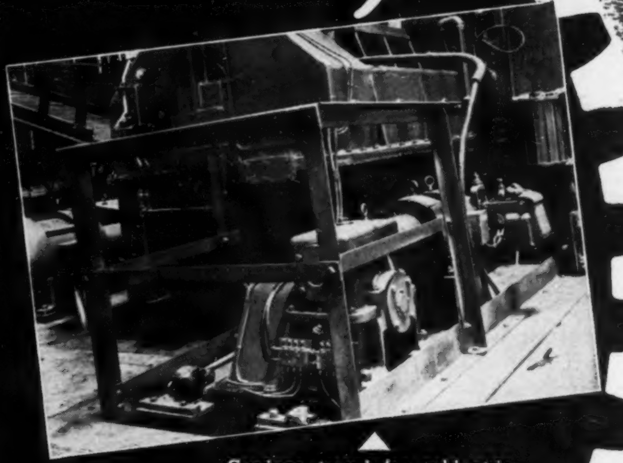
"Engineered Mills" TORONTO, ONTARIO, CANADA • LONDON, ENGLAND

# JONES DRIVES

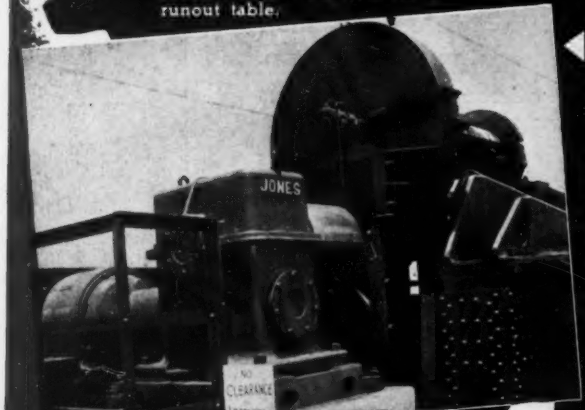
## *in the Steel Industry*



Jones double reduction Herringbone Reducer driving blooming mill slab pusher on runout table.



Carriage travel for cold strip processor driven by Jones worm gear.



Jones worm gear driving blooming mill crop conveyor.

Jones triple reduction Herringbone Reducer driving blooming mill shear approach table — adjustable side guards.

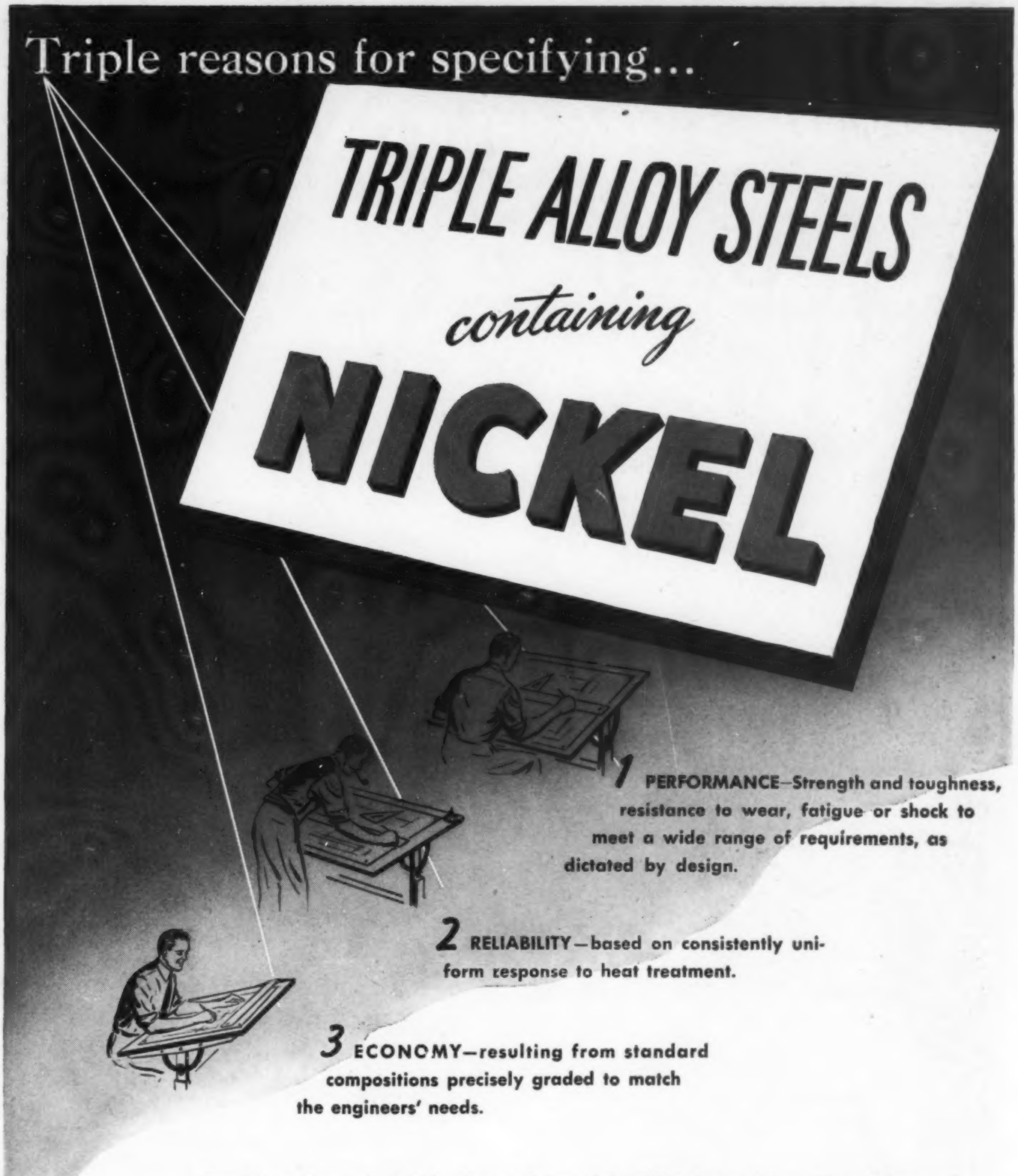
JONES
SIDE GUARD-WEST

• There are many sound reasons why Jones Herringbone and Worm Gear Reducers have been selected for these and many other applications in the steel industry . . . reasons which we believe you will also find sound and convincing when you are considering your drive problems. In any case we shall be pleased to place complete information in your hands covering speed reducers and other Jones transmission products.

**Jones**

HERRINGBONE · WORM · SPUR · GEAR SPEED REDUCERS • PULLEYS • GEARS • V-BELT SHEAVES • ANTI-FRICTION PILLOW BLOCKS • FRICTION CLUTCHES • FLEXIBLE COUPLINGS

W. A. JONES FOUNDRY & MACHINE CO., 4437 ROOSEVELT ROAD, CHICAGO 24, ILLINOIS



**1 PERFORMANCE**—Strength and toughness, resistance to wear, fatigue or shock to meet a wide range of requirements, as dictated by design.

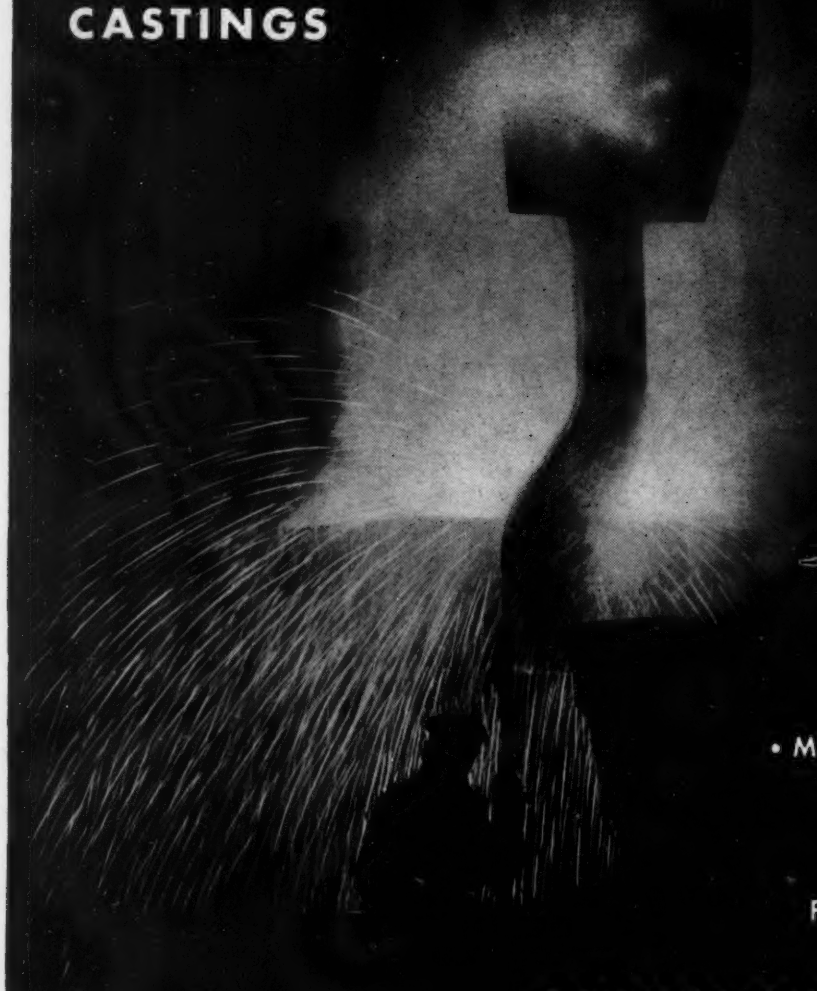
**2 RELIABILITY**—based on consistently uniform response to heat treatment.

**3 ECONOMY**—resulting from standard compositions precisely graded to match the engineers' needs.

Experience shows that triple-alloy steels containing Nickel are solving some mighty big problems in many industrial fields. They have established outstanding service records in some of the most exacting applications. The many standard compositions available make it possible to select *accurately*, and with economy, triple-alloy steels to fulfill the requirements of a great variety of applications.

We invite inquiries regarding the selection and uses of triple-alloy steels, containing Nickel.

**THE INTERNATIONAL NICKEL COMPANY, INC.** 67 Wall Street
New York 5, N.Y.



INCREASE PRODUCTION
BETWEEN *Stack* SHUTDOWNS
WITH HEAT-DEFYING
N·B·M
COPPER
CASTINGS

Exhaustive N-B-M research has perfected improved alloying and automatic pyrometer-controlled pouring techniques for Blast Furnace Copper Castings. The result: greatly increased heat resistance in your stacks' most troublesome burn-out points:

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For fewer shutdowns, always specify

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**BRONZE AND COPPER CASTINGS**

Blast Furnace Copper Castings • Roll Neck Bearings
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PITTSBURGH • NEW YORK

AMERICAN Brake Shoe COMPANY

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**WORCESTER**

*Engineering*

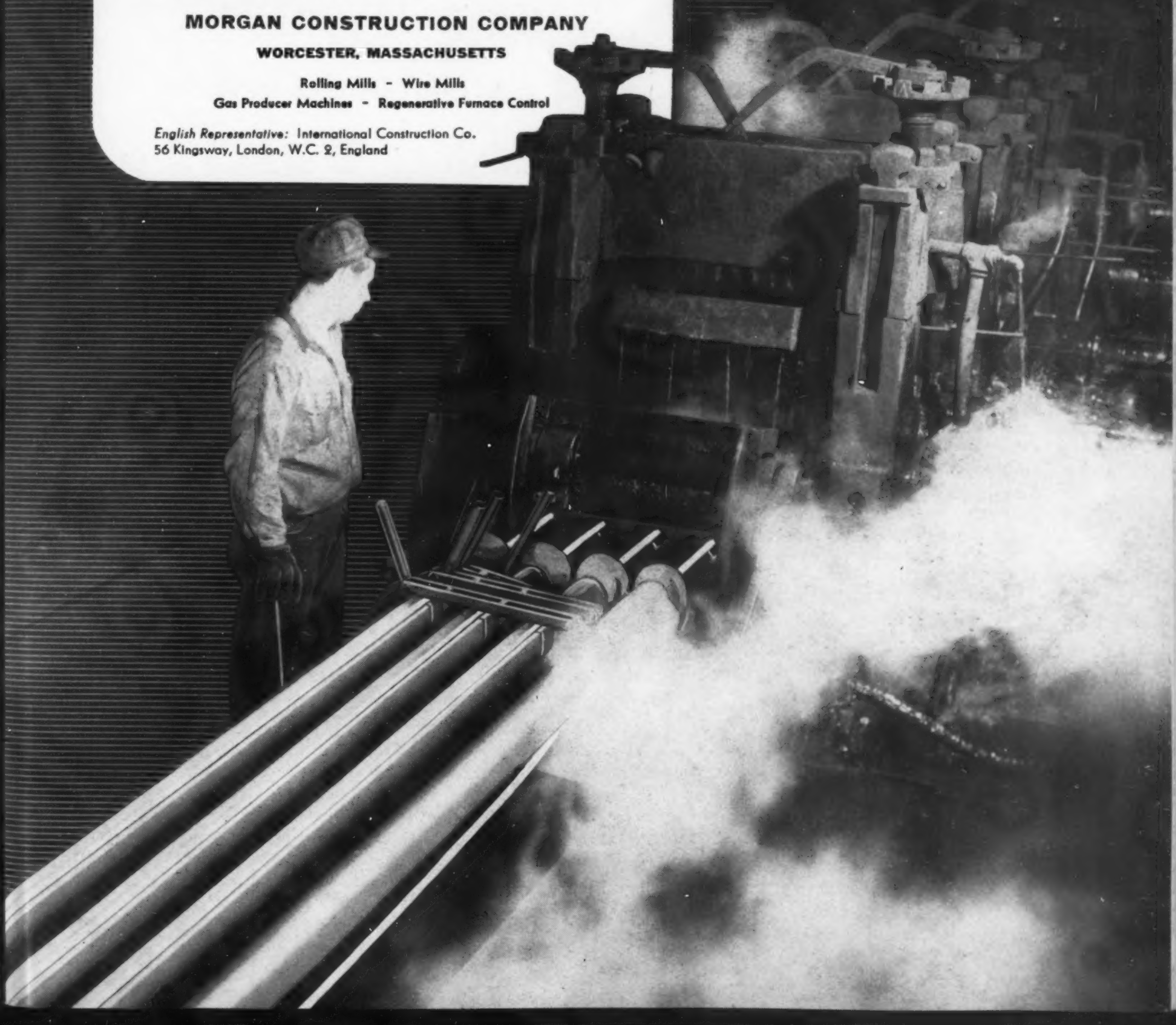
Why do you have confidence in a fine surgeon? Because he has had years of experience and you know he can meet any emergency that may arise.

MORGAN Engineers have the same type of experience . . . they have met and solved problems you probably never knew existed. This experience can be of real value to you. RM 1

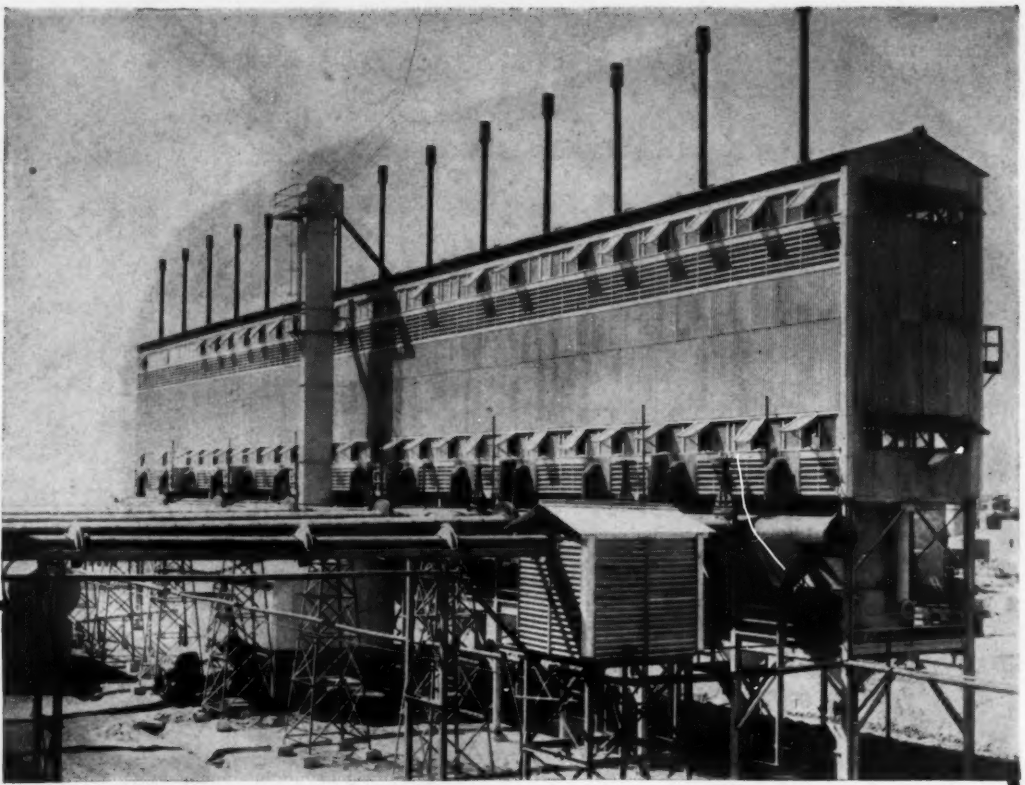
**MORGAN CONSTRUCTION COMPANY**
**WORCESTER, MASSACHUSETTS**

Rolling Mills - Wire Mills
Gas Producer Machines - Regenerative Furnace Control

*English Representative:* International Construction Co.
56 Kingsway, London, W.C. 2, England

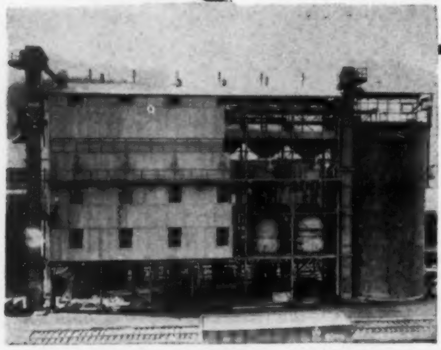


**14 largest-size Wellman-Galusha Gas Generators all installed in one building**

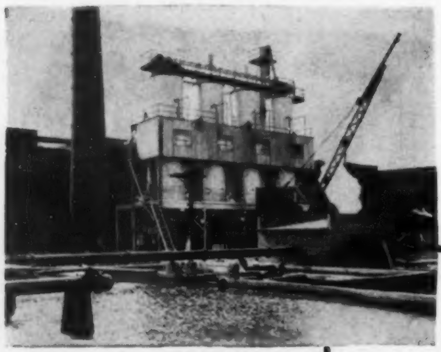


# WELLMAN MANUFACTURES THE FAMOUS

# *GALUSHA Clean Gas Generators*



*6-unit plant of 10' Wellman-Galusha Gas Generators*



*4-unit plant of Wellman-Galusha Gas Generators*

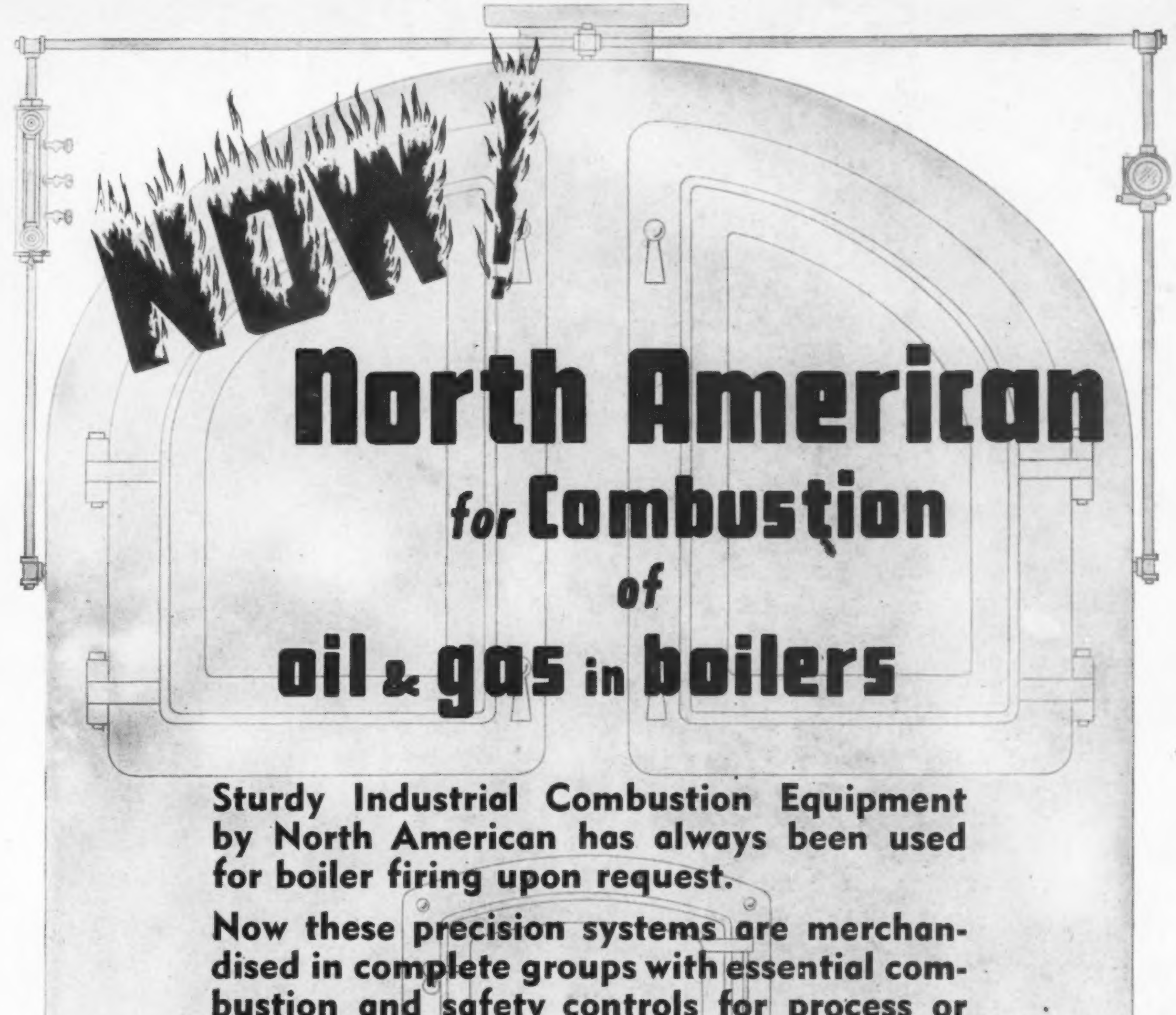
The Wellman-Galusha is a fully water jacketed gas generator with exceptionally efficient rotary grates, ample fuel storage bins and provision for the generation of steam required for gas making—all incorporated in the machine itself.

The lowest priced grades of Anthracite coal, "rice" or smaller, and coke, "pea" or "breeze", can be satisfactorily and economically gasified.

## WELLMAN WILL BUILD IT!

**Car Dumpers (all types)**
**Ore and Coal**
  **Handling Bridges**
**Gas Producers**
**Skip Hoists**
**Industrial Furnaces**
**Coke Pushers**
**Mine Hoists**
**Charging Machines**
**Soaking Pits**
**Special Cranes (Wharf, Dry-Dock, Hammerhead, Pontoon)**

**THE WELLMAN ENGINEERING COMPANY**
**7031 CENTRAL AVENUE • CLEVELAND 4, OHIO**



# North American for Combustion of oil & gas in boilers

**Sturdy Industrial Combustion Equipment by North American has always been used for boiler firing upon request.**

**Now these precision systems are merchandised in complete groups with essential combustion and safety controls for process or heating boilers.**

**Multiple burners for volumetric turndowns as low as 1/25 — single burners for simplicity — exceptional fuel-air ratio fidelity over entire operating range — easy maintenance — complete safety.**

**THE NORTH AMERICAN MFG. CO.**
CLEVELAND 4, OHIO
GAS OR OIL COMBUSTION EQUIPMENT
BRANCH OFFICES IN PRINCIPAL CITIES

EXIDE-IRONCLAD POWER MEANS *ALL-DAY-LONG* POWER

When your materials are handled by the efficient electric industrial truck—powered by Exide-Ironclads—you can always count on full shift availability. You can also count on faster, safer, easier handling and at a lower cost.

Exide-Ironclads have the *high power ability* needed for frequent "stop and go" service . . . a *high maintained voltage* throughout discharge, assuring a uniform rate of operations . . . and a *high capacity* that delivers peak performance throughout the shift. And their rugged construction keeps Exide-Ironclads steadily on the job, serving with dependability, safety, long-life and ease of maintenance.

Write us for a FREE copy of Exide-Ironclad TOPICS which contains "Case Studies" of materials handling problems. Tells how to cut handling costs up to 50% . . . cov[illegible] latest developments in handling materials from receiving to shipping.

THE ELECTRIC STORAGE BATTERY CO.
Philadelphia 32
*Exide Batteries of Canada, Limited, Toronto*

DEPENDABLE POWER

Exide
IRONCLAD

# Abreast of the Times!

## Reduce Installation Costs And Space Requirements for

**. . . Across-the-Line Motor Starting Equipment by using the ROWAN Type 780-KBF Oil Immersed Combination Motor Starter**

No special care is required for motor and control leads during installation.

Unit consists of sealed-off terminal compartment, disconnect switch, Rowan Air Seal Fuses, magnetic contactor and magnetic overload relays.

Overload relays are combination of inverse time element and instantaneous operation. Individually calibrated for 110% to 175% operation. Enclosure is mechanically interlocked to prevent lowering of tank when switch is in "ON" position or closing of switch when tank is lowered.

Rowan Air Seal Fuses . . . a proven short circuit protection . . . is a standard feature. Wherever atmosphere is contaminated with corrosive elements, semi-hazardous and hazardous vapors and dust . . . Rowan Oil Immersed Control has proved its dependability and complete safety. Users all over the country testify to its outstanding performance.

Write for complete information on the Rowan 780-KBF and other Rowan Oil Immersed Control Equipment.

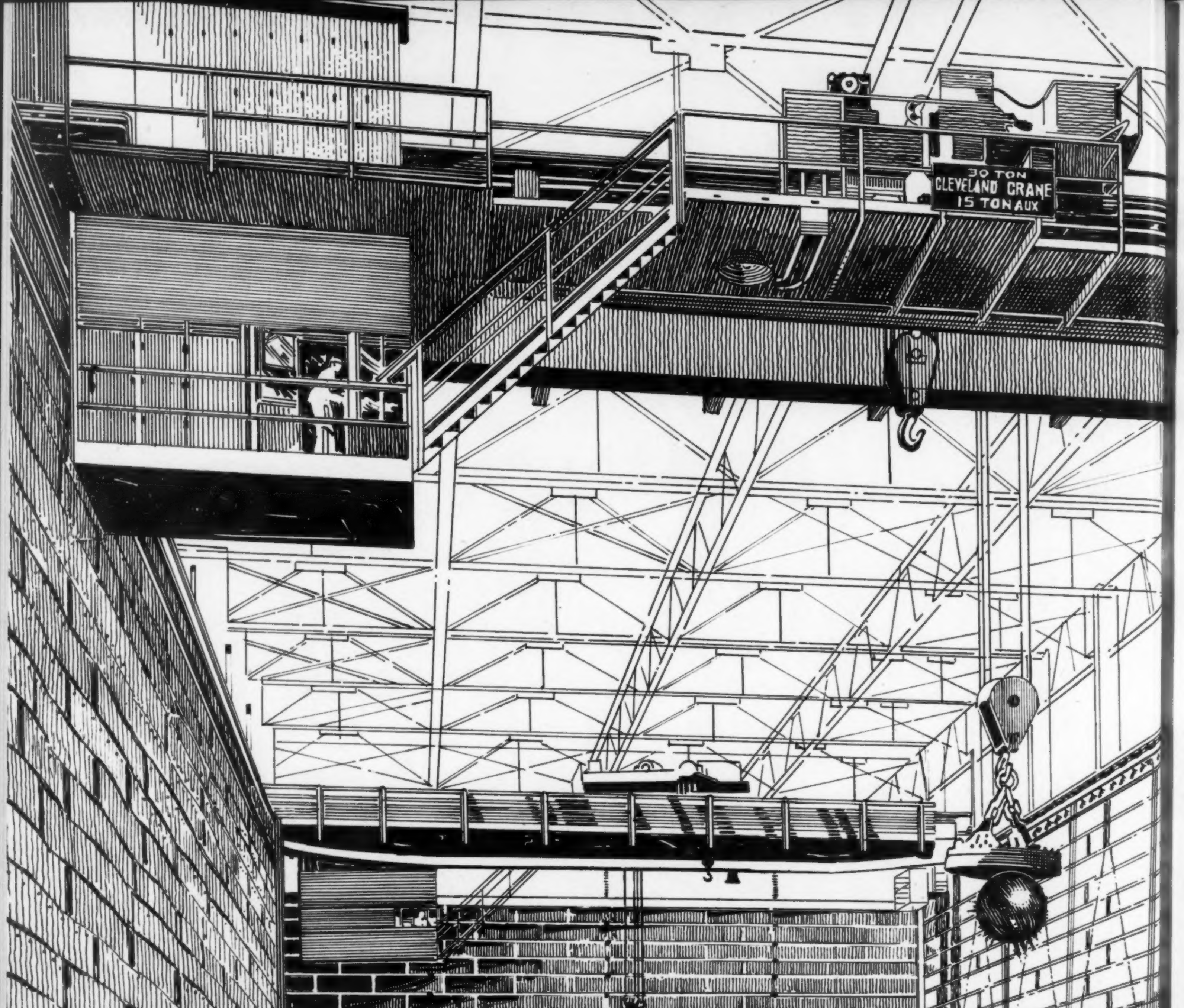
**MAX. HP AND FUSE RATING FOR 2 OR 3 PHASE, 3 POLE ONLY**

| FRAME | MAX. HORSEPOWER 25 OR 60 CYCLES |  | MAX. AMP. FUSE |
|---|---|---|---|
|  | 220 V. | 440-550 V. |  |
| 50 | 5 | 7½ | 30 |
| 100-B | 10 | 15 | 60 |
| 100-C | 15 | 25 | 100 |
| 150-B |  | 50 | 100 |
| 150-C | 25 | 50 | 200 |
| 300-B | 50 | 100 | 200 |
| 300-C | 75 | 100 | 400 |

**ROWAN CONTROL**

THE ROWAN CONTROLLER CO., BALTIMORE, MD.

*The Rowan Controller Company has specialized in Oil Immersed Controls for nearly half a century.*



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# CLEVELAND CRANES

MODERN ALL-WELDED STEEL MILL CRANES

# Crops *and* Shorts

IN spite of newspaper headlines stating that the steel strike is over, only about one-half of the original strikers are back at work. Basic producers are pretty much back to work. Fabricators and secondary processors are, in general, still down — and probably will remain so until some price relief is forthcoming. The squeeze on this section of the industry is serious and will ruin many small companies — indeed, already has.

▲

THE basic producing end of the industry, with their strike settled, can now look forward to a threatened coal strike. During the steel strike, some few steel companies were able to store up coal — the vast majority could not. Some producers will be forced to reduce steel output if a coal strike should run over two weeks. Many more will be hit by a 3 or 4 week strike.

▲

AND speaking of strikes, all we read about is "plants down and workers out." If it keeps up, we'll all be both down and out. It's time to put a long E sound in our wreck-conversion program.

▲

AFTER an analysis of the whole field, Westinghouse Electric Corporation recently predicted annual electrical equipment sales of $4,500,000,000 for the entire industry for at least five years. That ain't hay — in fact it's almost twice the volume of previous good years.

▲

FINANCIAL writers keep harping on the fact that liquid assets of the country are high — but all the stores seem to have only blends.

▲

ACCORDING to a radio address by Bradford B. Smith, of United States Steel Corporation: "The forgotten man is the stockholder. He is the owner who risks his savings to provide the tools of production, from which come more and better jobs for workers, more and better goods for customers and thus better living standards for all. The forgotten man is one who should not be forgotten."

PERHAPS much of the comment concerning the contrast in public relations of companies and unions during strike periods can be explained by this observation printed in American Brake Shoe's "Private Wire:" "Businessmen are forever trying to get along with the public on the basis of reason or logic. The politicians and the labor leaders know better; they use emotion."

▲

SAMPLES of newly discovered hematite deposits in the Algoma mining area in Ontario show iron contents of 62-68 per cent. Exploration of the field is proceeding. Located north of Lake Huron near Dean Lake, the deposits are claimed by Westland Mining Company, Ltd.

▲

LITTLE girls go for an all day sucker, but as they grow up they want one just for the evening.

▲

OPPOSITION to proposals for compulsory licensing of patents has been voiced in many quarters. The National Association of Manufacturers says it would "force an inventor to give up his exclusive rights before he has an opportunity to reap a reward, legitimize piracy of inventions, and hamper research."

▲

IT has been estimated that private industries spent approximately $650,000,000 for research in 1944.

▲

SHIPMENTS of iron ore in the United States during 1945 amounted to 88,156,000 gross tons, a decrease of 7 per cent from the 1944 figure of 95,135,675 gross tons. The past five year period has seen a record production of 482,000,000 gross tons of usable ore in this country.

▲

IN response to Life's poll of its foreign correspondents as to what the various countries think of the United States with its wave of strikes, etc., an answer came from England that "the British wish they could afford to be drunk and disorderly, too."

▲

DON'T forget to mark May 6-7 on your calendar as dates for the Association's annual spring conference, to be held again under the sponsorship of the Rolling Mill Committee at the Congress Hotel, Chicago, Illinois.

▲

MACHINE tool builders are driving hard on the cost reduction theme. One company says: "In the battle of costs to come, only those who use the most efficient tools and methods will survive. Now is the time to scrap your obsolete machines and replace them with good war surplus machines or new machines."

It is this same thought that has led to the multitude of rehabilitation projects in progress and under consideration in the steel industry.

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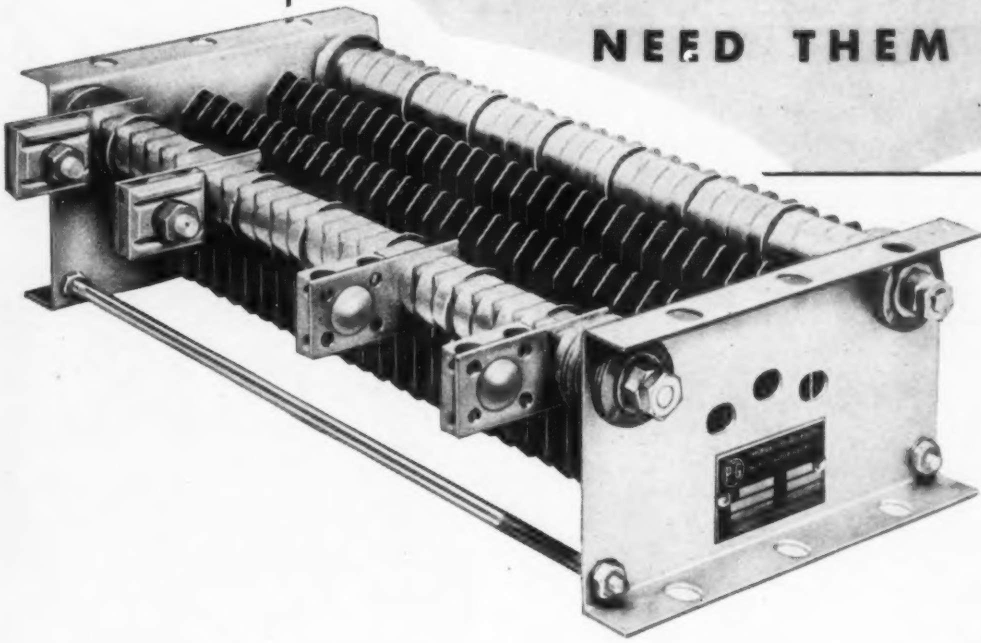

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*Write for Bulletin No. 500*

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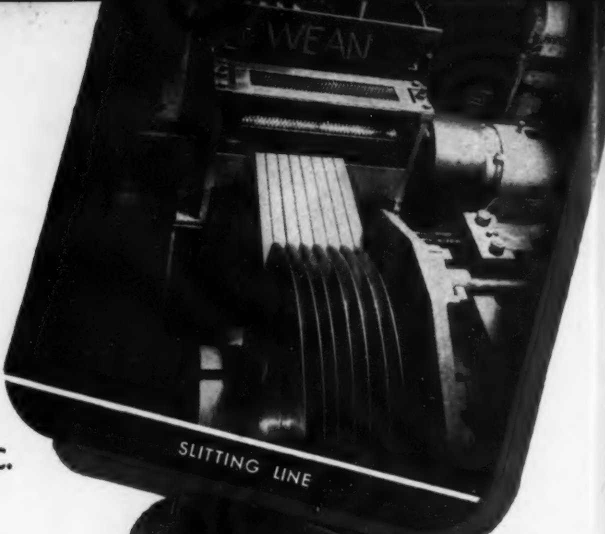
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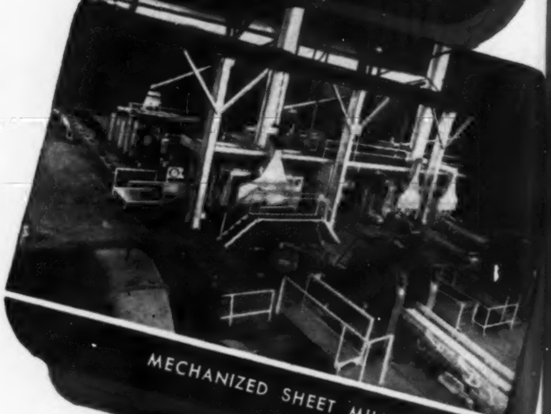
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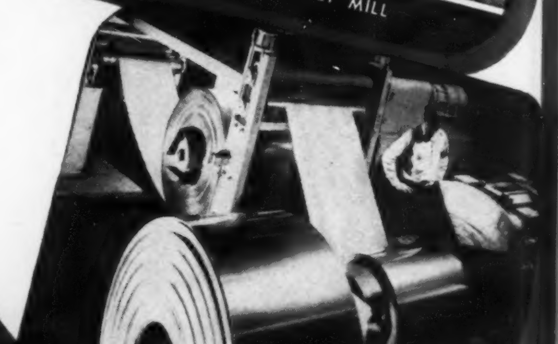
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# Iron AND Steel ENGINEER

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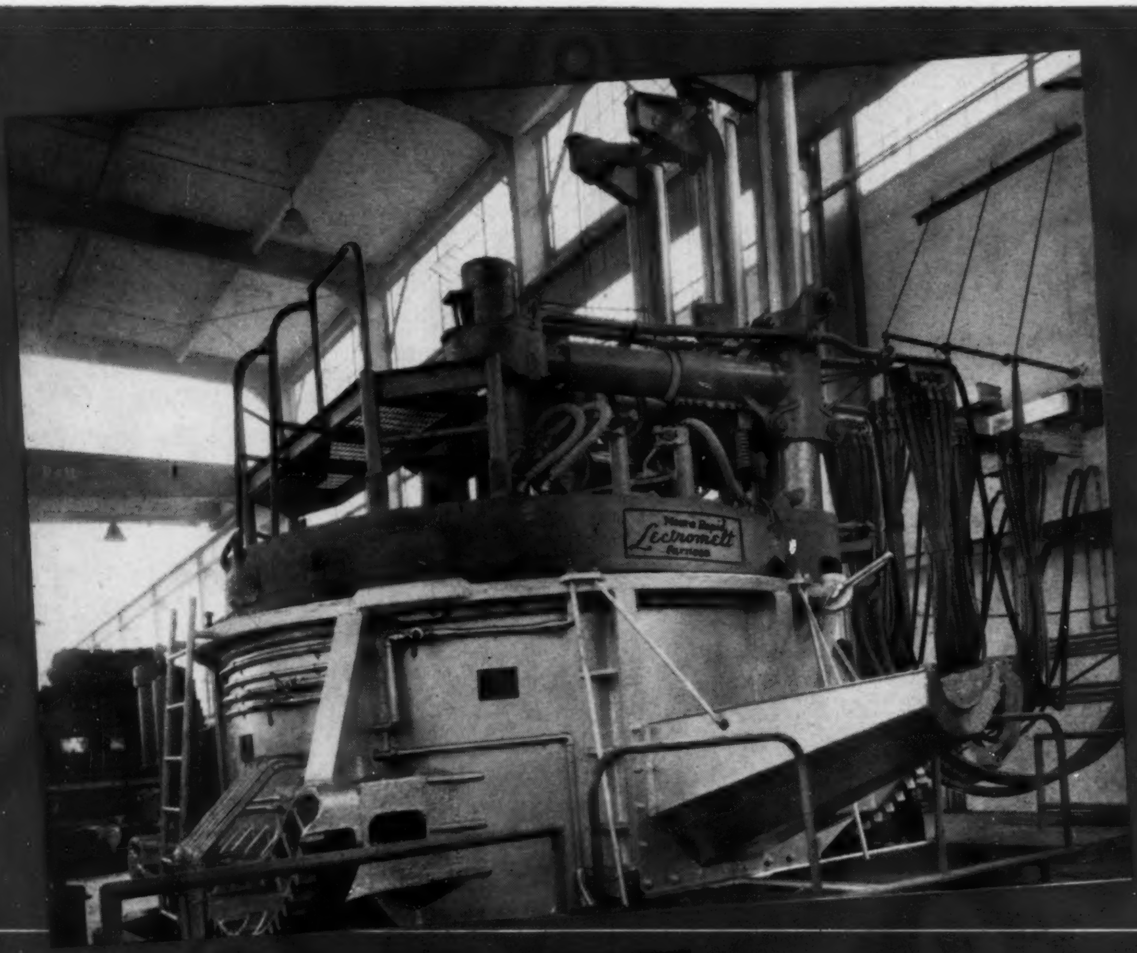

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**PITTSBURGH 30, PENNA.**

# SOME OBSERVATIONS ON

# *Seamless Tube Making*

*. . . . discussing various designs of piercing mills and some of the factors essential to the production of sound steel for the process . . . .*

*by Newell Hamilton*

SUPERINTENDENT, STEEL MILL

BABCOCK & WILCOX TUBE COMPANY

BEAVER FALLS, PENNSYLVANIA

▲ PROBABLY no other hot metal working process in the entire metal industry is less generally understood by the producer of ingots and semi-finished steel products than the rotary piercing process, which is the initial and most important step in the production of a high percentage of the tonnage of seamless tubing. Most technical literature on the subject of piercing mills has dealt with the engineering or mechanical aspects of the process and has avoided the practical problem of steel making involved.

Rotary piercing has gone through more than a half century of development and now occupies a position in the metal working industry of extreme importance. The principle of skew rolling, which was invented in the last century, has gone through refinements but is basically the same as it was in the original invention.

Three types of piercing mills have had commercial success. Listed in the order of their importance they are:

1. Mannesman or parallel axis barrel type roll piercing mill.
2. The 60 degree cone roll piercing mill.
3. The Stiefel or 180 degree disc mill.

These three general types of mills are shown in Figure 1. The first two are relatively much more important, and the text of this paper will deal with them exclusively.

In the early 1920's the expansion of the seamless tube industry brought about the most rapid engineering development of the piercing mill.

In the Mannesman type mills special attention was given to piercer pass design and the selection of the proper round diameters for a given size hollow.

During this period the writer's company undertook a program of development aimed at the improvement of the rotary piercing process which resulted in the adoption of the 60 degree cone type piercer with individual motor drive as standard equipment for this plant. A small piercing mill was built which was capable of piercing a 2 in. round in a great variety of methods. The axes of the rolls could be set at any angle to a vertical plane through the mill pass, and the feed angle — or angle between a horizontal plane through the mill pass and the roll axes — could be varied within practical limits. After an exhaustive series of tests involving some five years of experimentation, it was found that the 60 degree cone mill —

1. Required less horsepower per cubic inch of displacement in piercing.
2. Produced a smoother and more uniform hollow.
3. Was less critical of the tender or difficultly pierceable grades of steel.
4. Could more nearly approach the ideal surface speed relationship between piercer roll and hollow.

The detail data of this work have never been published

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Presented before Cleveland Session of A. I. S. E. Annual Meeting, October 3, 1945.

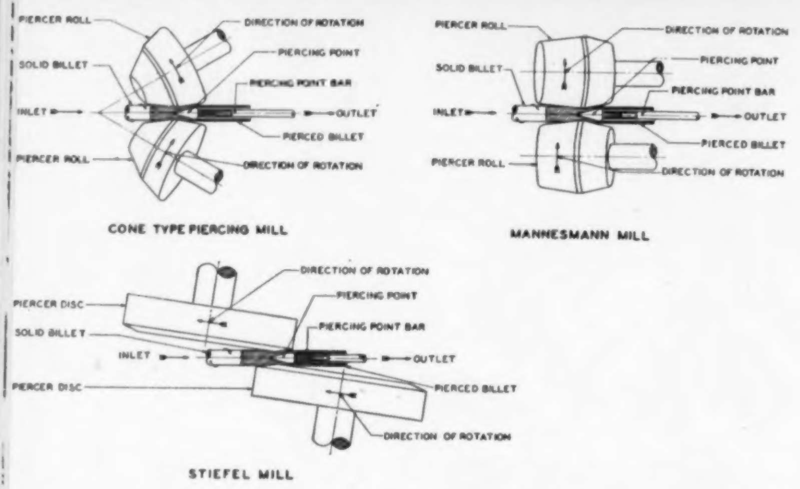

PIERCER ROLL
DIRECTION OF ROTATION
PIERCING POINT
SOLID BILLET
PIERCING POINT BAR
INLET
OUTLET
PIERCED BILLET
PIERCER ROLL
DIRECTION OF ROTATION
CONE TYPE PIERCING MILL
PIERCER ROLL
DIRECTION OF ROTATION
PIERCING POINT
SOLID BILLET
PIERCING POINT BAR
INLET
OUTLET
PIERCED BILLET
PIERCER ROLL
DIRECTION OF ROTATION
MANNESMANN MILL
DIRECTION OF ROTATION
PIERCER DISC
PIERCING POINT
SOLID BILLET
PIERCING POINT BAR
INLET
OUTLET
PIERCER DISC
PIERCED BILLET
DIRECTION OF ROTATION
STIEFEL MILL

**Figure 1 — Three common types of tube piercing mills.**

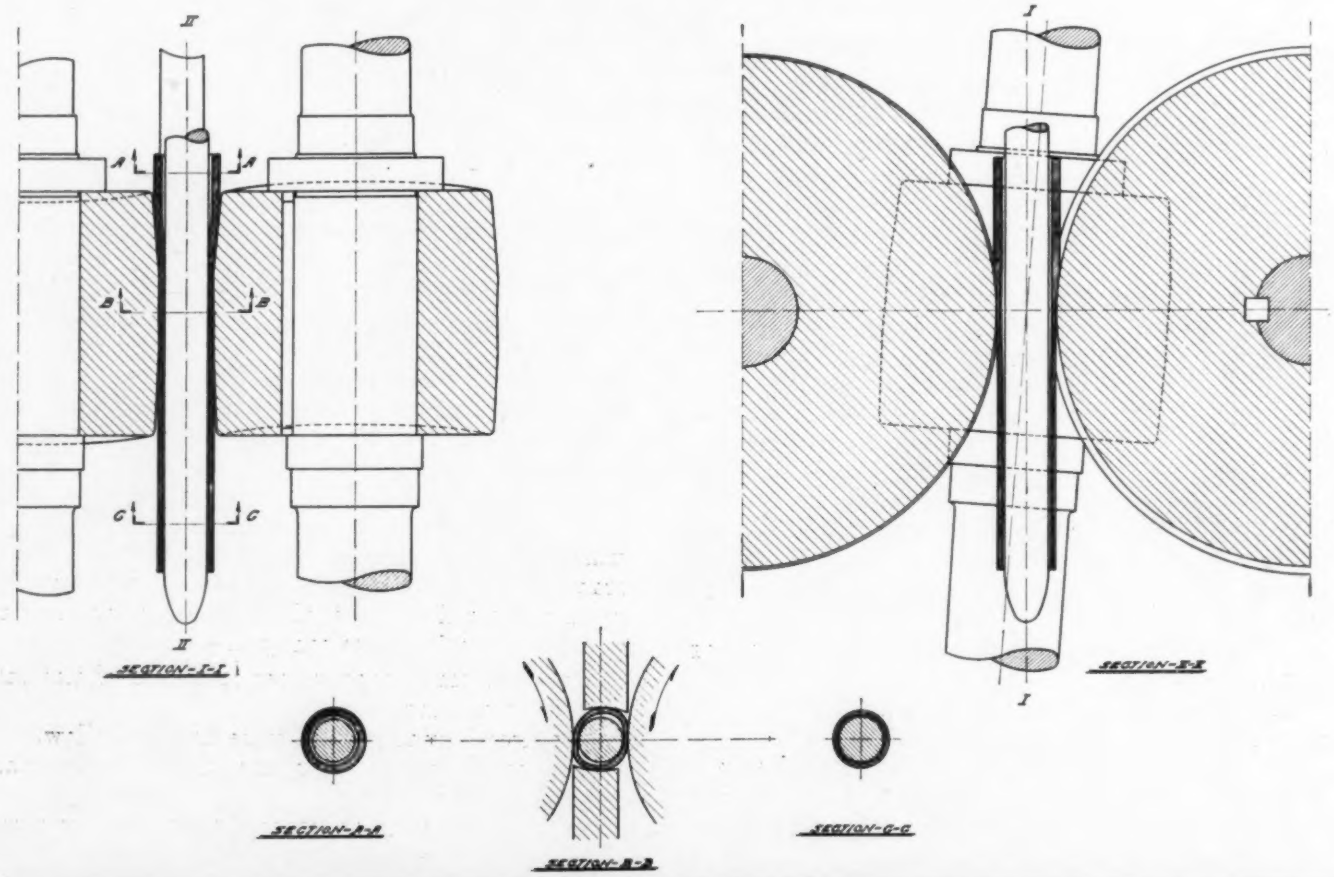
and are too lengthy to be included in this article. However, the practical application of this experimental work involving the construction of two such mills in the late twenties and early thirties has proven successful.

In the early thirties this company also undertook the development and practical operation of the Diescher elongator and the Diescher rotary guide shoe. This work led to the installation of this equipment by other major seamless producers. The elongator used as a secondary operation to rotary piercing produces a tube of extreme concentricity and with minimum wall thickness variation by skew rolling between the parallel axis rolls on a floating cylindrical mandrel with top and bottom rotary guide discs. Figure 2 shows a diagram of this unit. The rotary guide shoe assists the feed component of the mill and tends to reduce the guide shoe friction of the pass. The use of this last principle has also been extended to include piercing mills.

The larger seamless units have almost universally adopted the repiercing process as a means for producing long length light wall thickness hollows preliminary to plug rolling and finishing. This process is very similar to rotary piercing, and involves the skew rolling of a hollow over a stationary mandrel free to rotate. Figure 3 shows this process in diagram. Rotary rolling has been used as a means of producing very large diameter seamless tubing. Increasing speeds of piercing, piercing of extremely light walled hollows, the development of the rotary guide shoe, the development of special alloys for tools, and the expansion of the process of seamless tube manufacture to include high alloy stainless materials occurred during this decade. This development was aimed at the more rapid production of pierced hollows with a lesser power consumption, greater uniformity, and lighter wall thicknesses.

Basically, all rotary piercing has the common feature of the formation of hollow by peripherally rolling a

**Figure 2 — Sections of elongator used as secondary operation in rotary piercing to increase the uniformity in the dimensions of the tube.**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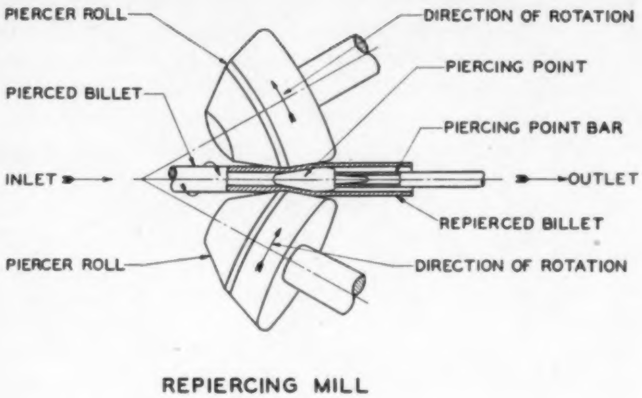


**Figure 3 — Repiercing mill used for producing large diameter seamless tubing. Mill, skew rolls hollow section over rotating stationary mandrel.**

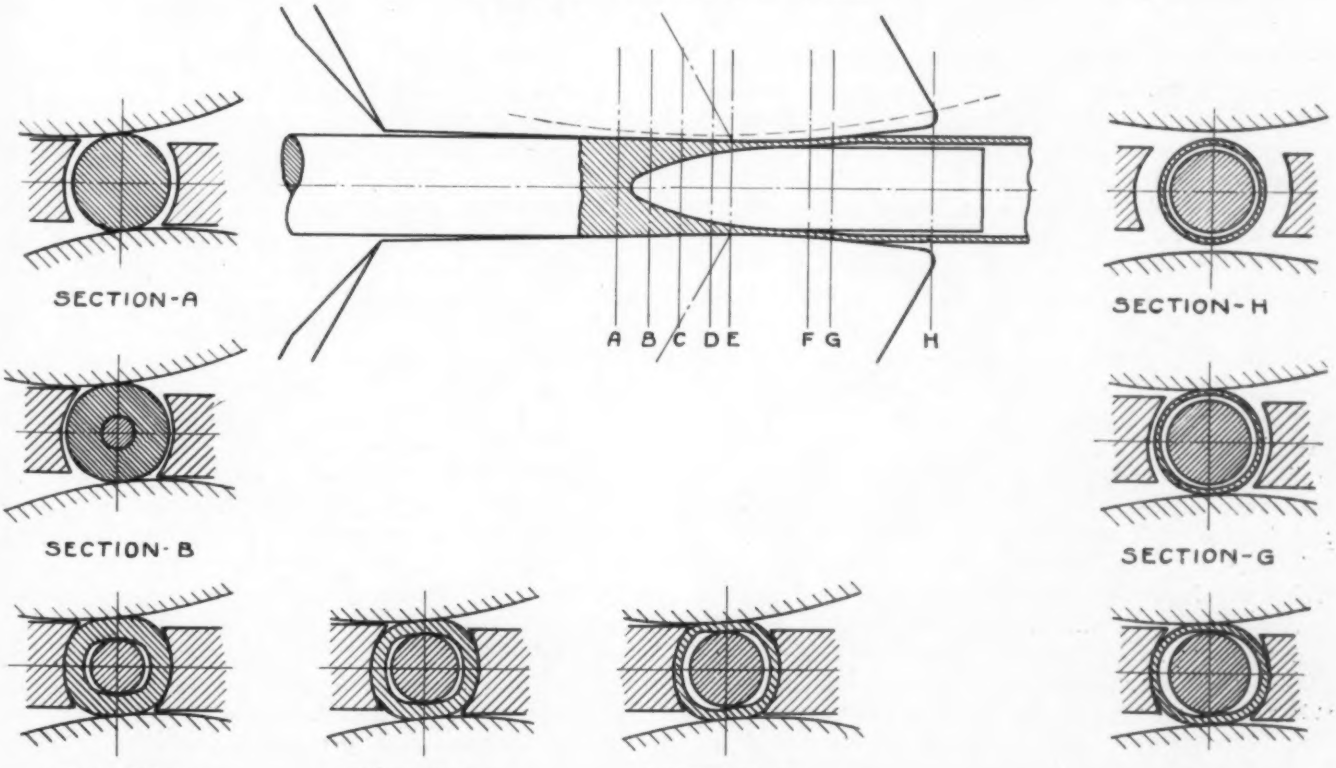
cylindrical billet over a conical mandrel by driven rolls set at an angle to the horizontal plane through the center line of the mill. The action of the piercer rolls or cones consists of gripping the billet, advancing it by reason of the skew rolling action imparted by the feed angle of the roll axes, reducing the diameter of the billet, and then rolling it over the mandrel. In order to prevent excessive expansion and control the diameter of the resulting hollow, guide shoes or discs confine the hollow in the central portion of the piercer pass. The wall thickness of the hollow is controlled by the relative spacing of the mandrel and the two piercer rolls. The diameter of the hollow is controlled by the placing of the guide shoes or discs.

Figure 4 shows a series of sections through a typical pierced hollow that was made on a 60 degree cone type piercing mill. In this it will be noted that the hollow passes through an oval or slightly rectangular section near the center of the pass, and is rounded up by the action of the piercer rolls at the outlet of the pass. At this point the external and internal periphery of the hollow is established and the rounding action separates the hollow from the mandrel so that it may be stripped from the piercer bar and passed along to the next operation of either re-piercing, plug rolling, or elongating.

The deformation of the steel in rotary piercing may be roughly separated into five elements as follows:

1. Peripheral skew rolling, largely compressive in nature and furnishing the advance or feed component of the process.
2. Wall thickness reduction of the hollow, which may be likened to action of a three-high mill with a relatively small and idling tapered middle roll and a loop of stock being forced up the taper and reduced in thickness as the top and bottom rolls are rotated.
3. The bending action on the outermost and innermost surfaces of the hollow caused by the rotation of the oval or roughly rectangular section as it advances in the mill.
4. The abrading action on the inner and outer surfaces of the hollow caused by differences in the relative surface speeds of the hollow, the mandrel, the guides, and the rolls.

**Figure 4 — Sketches of a typical pierced hollow made on a 60 degree cone type piercing mill show shape of section at different stages of the pass.**



5. Twisting action caused by the differential peripheral speeds of the hollow and the rolls at various points in the pass.

The sum total of these elements combined with the rather rapid rate of piercing, which has been developed on the more modern mills, is an indication of what must be expected from a piece of steel in this process. Experience has shown that tube steel must have the following properties in order to make a defect-free seamless tube:

1. It must have a dense outer surface free from any longitudinal defects or radial planes of weakness.
2. It must have good high temperature ductility over a sufficiently broad range of temperature to permit the piercing of hollows of commercial length and to allow for any temperature buildup which may occur as a result of the deformation.
3. It must be free from pipe or center porosity or any internal defect near the center of the billet that may open up on the inside of the bar in the process.

The above properties must be super-imposed upon any other metallurgical, chemical, or physical properties dictated by the use for which the tubular product is designed. In some instances, particularly in the high alloy steels of the stainless type, it has been found necessary to balance the alloy constituents in an effort to stabilize the phase of the alloy and effect improvement in high temperature ductility. There are still a few high alloy compositions that are considered wrought alloys in bars and flat rolled products that cannot be made into seamless tubing because of their hot working characteristics. However, these grades are few, and by and large the seamless tube producers have developed methods for the production of practically every commercial ferrous alloy from pure iron to 25 per cent chromium, 20 per cent nickel, and a great many nonferrous alloys including the brasses, copper, nickel, monel, and 88 per cent nickel, 12 per cent chromium.

In the past 20 years a great deal of laboratory work has been done on the question of high temperature ductility in an effort to develop acceptance tests for tube billet steel. Static tensile tests at elevated temperatures, drop hammer tests, hot bend tests, and twist tests have been used in these investigations. Most of this work has been inconclusive insofar as determining the deformation characteristics of steels and their adaptability to a piercing mill. Correlation of tests of this type with actual tube piercing has not been entirely satisfactory.

While the war has curtailed a great deal of experimental work of this type, some investigators have gone so far as to contemplate the construction of a small experimental piercing mill for the study of this problem. A limited amount of experimental work of this nature was done by our company, using the experimental piercing mill that was described earlier in this paper. In this work various high alloy grades of stainless materials were pierced over a range of temperatures. Records were kept of the condition of the hollows and the power and time required to make a standard pierce. Other development work interfered with a continuation of this test program, and today this experimental mill is being used as part of a regular producing unit which was assembled during the war emergency.

For the most part, the most valuable information with regard to steel performances on piercing mills has been received from actual records made over a period of years and collected by competent and well-trained observers in the plant.

The accurate observation and recording of data from the melt shop through the inspection of the hot rolled tubular product and a systematic control of all variables in the entire process are the most important elements in the production of good tube steel. At times a seemingly insignificant detail of manufacturing will be found to be the key to the success or failure of the process. Experience of a great many years in the production of seamless tubing has fairly well systematized the recording of data on the tube making. However, it is wrong to assume that new phases of this work do not develop from time to time.

Early in the development of systematized data recording and production control in the seamless process, it became obvious that the extension of this procedure into steel making was a necessity. Some years ago engineering work was started on a steel producing unit to be integrated with the seamless mills at The Babcock & Wilcox Tube Company's plant at Beaver Falls, Pennsylvania. Actual construction of such a unit was started in the fall of 1941 and operations began in June of 1942.

The plant layout is shown on Figure 5, and consists of two 15-ton basic electric furnaces of the top charge type, a battery of soaking and preheat pits, an 8-ton steam hammer with a manipulator, which serves as a blooming mill, a 24 in. three-high bar mill with furnace, and both bloom and round conditioning facilities. The shop is arranged for material flow as shown in Figure 6. The raw materials in the form of scrap enter the eastern end of the melt shop bay. Practically all of the necessary scrap is generated in the tube mill located approximately one mile to the south and east of this plant. The bar mill rolls the product of the furnaces, and, under present operations, approximately the same quantity of open hearth steel blooms is purchased on the outside. Such facilities as yard service, control laboratory, and a portion of the maintenance of the shop are common to the main plant. A separate power system is maintained with a direct 66 kv line connected into the district power system through a sub-station at the plant, which reduced this voltage to 11 kv for the furnace transformer primaries and the general power transformers of the plant.

The electric furnaces melt average heats of 45,000 lb at an average melting rate of four net tons of ingots per hour from each unit. The furnaces have 12 ft shells and are equipped with 6000 kva transformers which supply ample power for rapid melt-down and adequate bath temperature control. This size of furnace was selected after a study of the order quantities, and it has been proven to be economical in operation and flexible in scheduling. The operation of the two units permits the staggering of melt-downs, and with automatic current demand limiting equipment, excellent load factors are attained.

Practically the entire range of ferrous alloys has been melted in these furnaces from low carbon steel to 25 per cent chromium, 20 per cent nickel, all with double slag practices and under rigid control. Melt procedures are set up for each grade, and any deviation from the

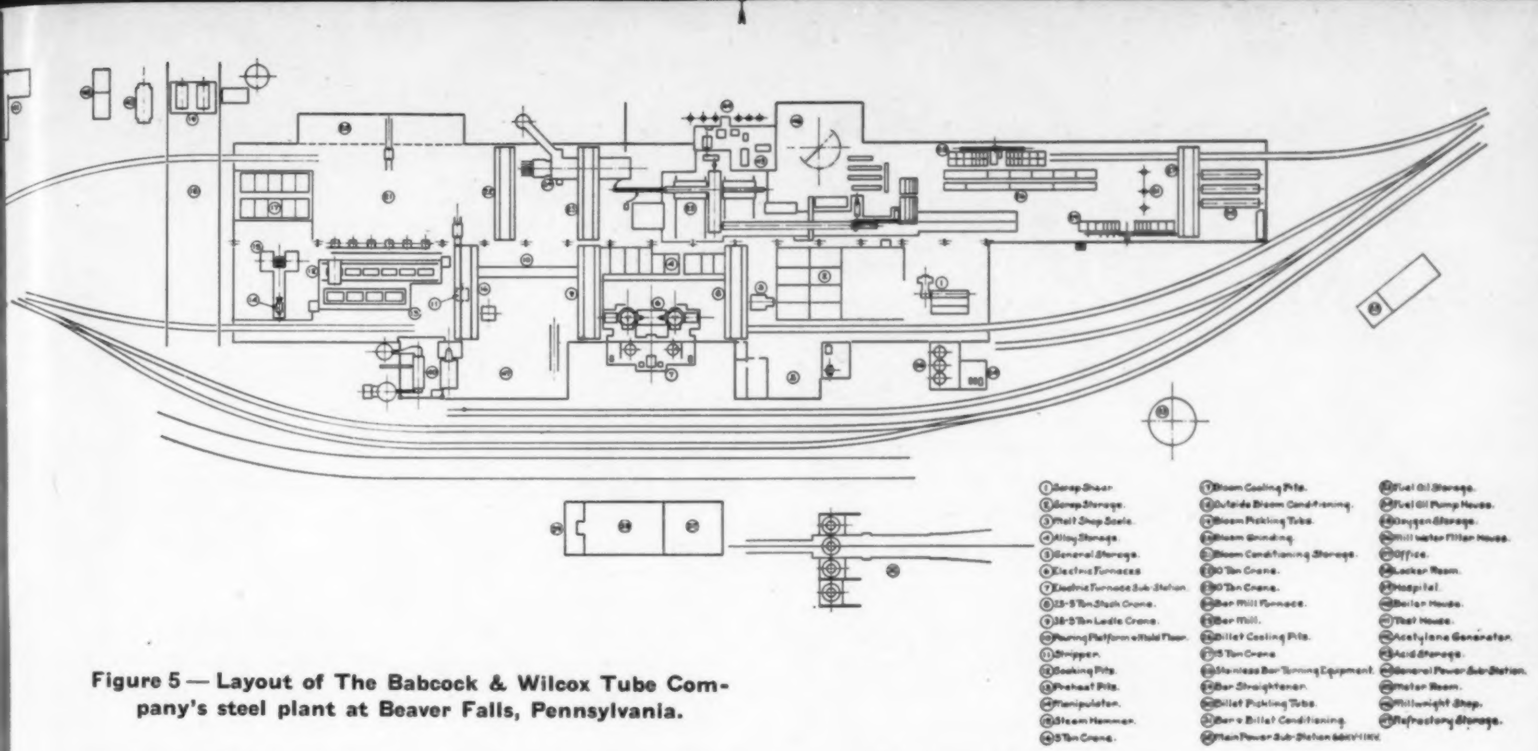
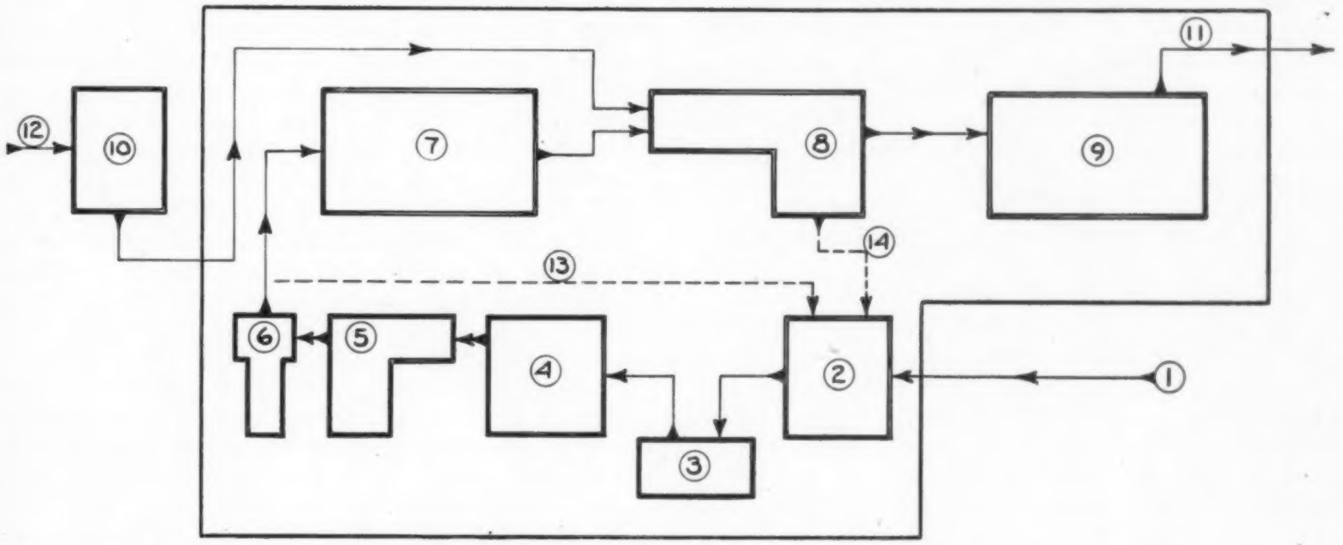

① Scrap Shear
② Scrap Storage.
③ Melt Shop Scale.
④ Alloy Storage.
⑤ General Storage.
⑥ Electric Furnaces
⑦ Electric Furnace Sub-Station.
⑧ 25-5 Ton Stock Crane.
⑨ 35-5 Ton Ladle Crane.
⑩ Pouring Platform & Mold Floor.
⑪ Stripper.
⑫ Soaking Pits.
⑬ Preheat Pits.
⑭ Manipulator.
⑮ Steam Hammer.
⑯ 5 Ton Crane.
Bloom Cooling Pits.
Outside Bloom Conditioning.
Bloom Pickling Tubs.
Bloom Grinding.
Bloom Conditioning Storage.
10 Ton Crane.
10 Ton Crane.
Bar Mill Furnace.
Bar Mill.
Billet Cooling Pits.
15 Ton Crane
Stainless Bar Turning Equipment.
Bar Straightener.
Billet Pickling Tubs.
Bar & Billet Conditioning.
Main Power Sub-Station 66KV-11KV
Fuel Oil Storage.
Fuel Oil Pump House.
Oxygen Storage.
Mill Water Filter House.
Office.
Locker Room.
Hospital.
Boiler House.
Test House.
Acetylene Generator.
Acid Storage.
General Power Sub-Station.
Motor Room.
Millwright Shop.
Refractory Storage.

**Figure 5 — Layout of The Babcock & Wilcox Tube Company's steel plant at Beaver Falls, Pennsylvania.**

**Figure 6 — Schematic diagram showing flow and processing of materials in the plant shown in Figure 5. Item 1 shows incoming scrap and raw material, 2 shows scrap preparation and storage, 3 shows the electric furnaces, 4 shows the pouring floor, 5 shows the soaking pits, 6 shows the hammer, 7 shows bloom conditioning, 8 shows the bar mill, 9 shows bar and billet conditioning, 10 shows purchased bloom conditioning, 11 shows outgoing bars and billets, 12 shows incoming purchased blooms, 13 shows hammer scrap, and 14 shows bar scrap. (below)**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prescribed procedure must be explained; and the particular heat in question is very carefully scrutinized throughout its processing.

Changes in melt procedure are made only when positive evidences in the production records indicate that a change is necessary, and all such changes are carefully analyzed by the mill metallurgist and melt shop superintendent. Due to the relatively short processing cycle from melt shop to finished tube possible in an integrated unit of this type, the results of any changes in melting procedure can be studied to a conclusion without seriously interfering with production schedules. Frequently, when a new grade or composition is produced, one or more heats are melted to a specific procedure, processed to completion, and the product and processing record very carefully reviewed before further melting is started. In the operation of this system indiscriminate changes in melting procedure are avoided and frequently the experience gained on one grade or analysis is of great help in establishing procedure for new grades. This system is also used in developing all other processing procedures throughout the plant.

The general features of electric furnace melt procedure that contribute to the production of quality alloy tube steel are mainly concerned with thorough degassification of the melt. This is particularly true of the low carbon alloys that contain substantial amounts of chromium. The most effective means of degassification has been found to be a good carbon boil near the end of the oxidizing period just before the slag is tapped off. Care must also be exercised in the formation of finishing slags which require substantial amounts of

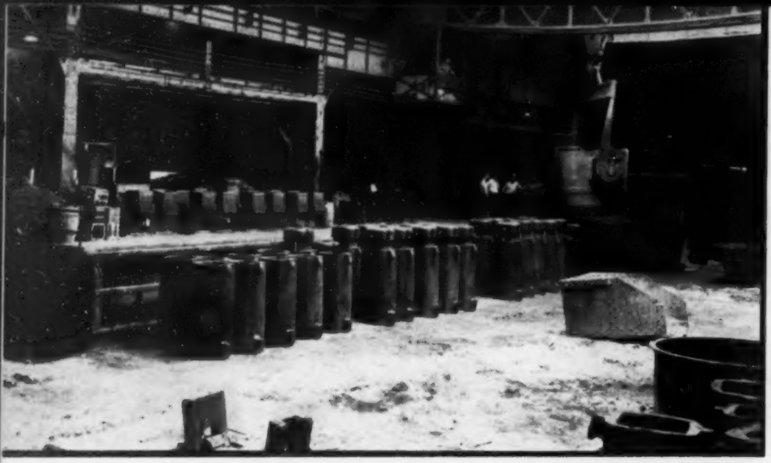

**Figure 7 — Pouring platform where all hot top preparation is handled for the tube steel ingots.**

reducing agents such as silicon, carbon, or aluminum. Good ingot surfaces are also important and require care in mold preparation and good teeming practice.

In establishing the ingot practice for the plant, consideration was first given to the production of sound, pipe-free ingots by the use of ample hot topping and conservative ingot shapes. Tube billets from 2000 pounds down to 30 pounds had to be produced with reasonable yields. This problem was solved by using two lengths of ingot mold of the same top cross section, with each permitting a variation of 8 in. in ingot length by floating the hot top. As a result, variations in ingot weight from 3400 to 5200 pounds are possible in only two 19½ in. fluted square molds, one of which is 53 in. in height and the other 59¾ in. in height. These molds are double taper, plug bottom, and take the same hot top equipment. Ingot weights are calculated before melting for each specific billet multiple to be produced, and standard cropping is allowed for in this calculation. Permanent hot top equipment is used on all production and all hot top preparation is performed on the pouring platform. Figure 7 shows this portion of the shop.

The soaking pits are one-way oil-fired with automatic temperature and pressure control, and are of proper size to receive the product of one heat. The battery of preheat or holding pits is also fired by oil and acts as a bank or reservoir for the storing of ingots ahead of this unit. Ingots of alloys that require special thermal treatment or are subject to cracking from thermal stress are held and equalized in these pits before further processing.

Special attention is paid to soaking pit practice, and ingot heating cycles are prescribed for all grades of steel. In all cases careful attention is paid to the temperature uniformity of the pit and a rapid means for manipulating the pit cover during ingot drawing is provided in order to maintain this temperature uniformity.

Using a steam hammer and manipulator as a blooming mill has proven to be a very satisfactory and economical solution to a difficult scheduling problem in a shop of this size. This unit can bloom ingots at a rate of from 10 to 15 net tons per hour and is scheduled to operate at approximately 85 per cent of the scheduled melt shop operations. The extreme flexibility of the hammering process makes it possible to reduce an ingot in any manner. These control features are very valuable in the handling of high alloy or tender steels that are subject to ingot bursts during the early breakdown passes of blooming. The beneficial effects of forging steel have long been spoken of in the metal industries and the experience with this process has verified these beliefs. It is thought that the relatively cold surface temperature of the forged bloom during finishing as compared to a blooming mill operation tends to form a dense outer surface that persists through rolling and subsequent tube piercing.

Another important element in the use of a hammer for blooming is the fact that it serves as an excellent means for predicting the hot workability of the steel. A detailed record of the hammer performance is kept on each heat of difficult workable steel; and frequently a heat is scrapped at this stage of the processing because of its behavior in forging even though it might be reclaimed by bloom conditioning. Hammering tends to open up and disclose a crack or ingot burst and does not close and partially weld such defects as is the case in a more rapid blooming operation at a higher finishing temperature. This is of considerable aid in bloom conditioning and prevents the formation of undetected planes of weakness in a bloom that are usually carried through the rolling process and not disclosed until tube piercing.

Bloom conditioning on all analyses containing less than 4 per cent chromium is done by torch scarfing. All analyses in this group containing more than 0.20 per cent carbon or 0.65 per cent molybdenum are preheated to from 400 to 600 F for this operation, while those under this chemistry are scarfed cold. The entire surface of each bloom is treated in this manner, and the scarfing torch is used as a means of exploring and detecting defects in the bloom as well as a means for removing them. All analyses containing more than 4 per cent chromium are ground, and here again the entire surface of each bloom is inspected after a preliminary skinning operation and then re-ground before final inspection. The importance of a defect free bloom surface cannot be over emphasized in the production of tube steel. The investment in conditioning hours at this stage of the process is well repaid by a decrease in rejections at later stages in the production of a tube.

Heating for rolling is accomplished in a pusher-type continuous furnace with two firing zones. This furnace is oil-fired and equipped with automatic temperature and pressure control. Rolling is performed on a 24 in. mill consisting of two three-high stands, and one two-high stand, all on the same constant speed drive. The mill is equipped with traveling tilt tables and substantially all reductions are in box passes. Only guide rounds are rolled in sizes from 2¼ in. to 7½ in. diameter. Rounds from 5½ in. to 7½ in. diameter are rolled from 10 in. × 11 in. blooms up to a maximum weight of 4400 pounds. Other bloom sizes overlap for convenience in scheduling. For example: 3 in. to 5½ in. diameter, inclusive, can be rolled from 9 in. × 9 in. blooms; 3 in. to 4½ in. diameter, inclusive, from 7½ in. × 7½ in. blooms; and 2¼ in. to 3½ in. diameter from 6 in. × 6 in. blooms. The necessity for rolling all types of steels demands conservative pass reductions and the large number of sizes demands a flexible arrangement of sizes by roll sets to avoid frequent mill changes. Practically all of the electric furnace steel is cut to tube billet weight by oxyacetylene torch or hot saw on the delivery table of the mill. All grades containing less than 5.5

per cent chromium can be torch cut, while grades over this chemistry must be hot sawed. Under present operations approximately 50 per cent of the tonnage of this unit is carbon steel rolled from open hearth blooms purchased on the outside. Most of this product is finished in mill length bars of from 22 ft to 32 ft in length.

Cooling pits are available for the slow cooling of analyses requiring this treatment at the finishing end of the bar mill. All of the product of this mill, with the exception of stainless steels, is pickled and inspected before shipment. Conditioning of rounds is performed by grinding or chipping, and all of this work is done in the rolling mill bay. All of the stainless steels produced are rolled from $\frac{3}{16}$ in. to $\frac{1}{4}$ in. larger in diameter and turned to finished size in mill length bars. Experiences indicate that round or billet conditioning can be over emphasized and is not nearly as effective a means for producing defect-free tube billets as bloom conditioning. Manhours of conditioning time in this portion of the plant have been reduced greatly in the course of operations with an actual improvement in seam rejections in the tube mill. Careful attention to roll pass design and experience gained in the inspection and classification of defects that are likely to produce a defect in the tube have been responsible for this reduction in conditioning time.

In conclusion, it may be stated that the three years of operations of this unit have proven conclusively the value of integrating the production of alloy steel and seamless alloy steel tubing. In a large measure the success of these operations may be attributed to the cooperation of the melt shop with the mill metallurgical staff, inspection department, and seamless hot mill units of this plant. The clearing of all information through the mill metallurgical staff and through the mill observer corps has proven to be a very satisfactory system.

# DISCUSSION

PRESENTED BY

**H. R. McLAREN, Timken Roller Bearing Company, Steel and Tube Division, Canton, Ohio**

**NEWELL HAMILTON, Superintendent, Steel Mill, Babcock & Wilcox Tube Company, Beaver Falls, Pennsylvania**

**P. C. DALE, Republic Steel Corporation, Massillon, Ohio**

**H. E. ENGELBAUGH, Assistant General Superintendent, Youngstown Sheet and Tube Company, Youngstown, Ohio**

**H. R. McLaren:** The main thing I would like to bring up is the question of the surface in piercing with special reference to what we term "woody surface" at Timken, but which a lot of other people call "fish-scale surface." I would like to hear what some men may have to say relative to that surface, because I feel that is one of the most important points in regard to the production of the higher-alloy tubes. I am sure that all who produce the higher alloys have run into this condition.

It is a question whether this surface comes from the melt shop or whether it comes from the tube mill. In my own case, I feel it comes from the melt shops, because I have had specific examples which eliminate the tube mill. As an example, one day in piercing 35-15 alloy we had four heats of four billets each. There was absolutely no change in the billet heating furnace in any of these heats. Their heating cycle was exactly the same, and they were all run together with no change on the heat. Yet one of these heats developed a very pronounced fish-scale surface. The other three heats were absolutely perfect.

I bring up this topic because I feel that this fish-scale surface is one of the most detrimental things that we have to overcome and we have developed no test to predict this condition. We use twist tests at Timken to determine pierceability with very good success, but it tells one nothing about whether one will get fish-scale condition or not. We get heats that we feel are satisfactorily pierceable, put them in the mill and find that we get fish-scale and must scrap the material. Sometimes cleaning up the surface either by grinding or by turning will remove it, and other times it won't.

**N. Hamilton:** There is no question but that everybody has experienced what we call "checking" and some call "fish-scale" in the piercing of high alloy tubing. Some years ago, I participated in an investigation that concerned this problem. The conclusions at that time were that the degree of oxidation of the bath at the time of tapping was responsible for this phenomena. We still feel that these conclusions are correct; however, as indicated in the paper, other gases, such as nitrogen and hydrogen, may have some bearing on the problem. The statement made that gas free steel with good deoxidation practice is necessary in the production of high alloy tube steel cannot be debated.

There are certain elements of a piercing mill setup and piercing temperature that can also contribute to the formation of "checked" pierced hollows, but the number of times that Mr. McLaren's trouble has been noted in the processing of a succession of heats is all too frequent. A careful survey of melt shop records generally indicated poor de-gassification at some stage in the processing when heats behave in this manner.

**P. C. Dale:** I notice Mr. Hamilton places very much importance on his observer records, and we feel that the cooperation of the piercing mills and the steel mills in coordinating these records with our observer records is very valuable. We also appreciate that the internal soundness and surface are both very important.

**H. E. Engelbaugh:** What is your opinion of conditioning rounds by torch scarfing? Speaking of torch scarfing of rounds, it is necessary, in order to remove some defects, to go below the dense outer surface of which you speak. To what depth of dense outer surface are you referring?

**N. Hamilton:** We do not torch scarf rounds prior to piercing, and the dense surface that I referred to in the paper varies from $\frac{5}{8}$ in. to $1\frac{1}{2}$ in., as shown by etched bloom sections. This is below any scarfing depth, and, furthermore, the heating effect of the scarfing torch is so localized that it has very little effect on the bloom surface. It is my opinion that a valuable part of the scarfing torch operation is concerned with the training of the operators to remove the defect which, in most cases, is quite easily detected in the scarfing flame.

# DEVELOPMENT AND APPLICATION OF *Twin Motor Drive*

***. . . . the experience of the past sixteen years has shown the value and possibilities of twin motor drives . . . . in the future such drives will increase in number and undoubtedly will be extended to many new applications . . . .***

*by G. E. Stoltz,* MANAGER
METAL WORKING SECTION
WESTINGHOUSE ELECTRIC CORPORATION
EAST PITTSBURGH, PENNSYLVANIA

▲ THE use of electricity in steel mills has had a considerable influence in the development of the methods used to manufacture steel products. Probably the first recorded use of electricity in this industry was the installation of a two light arc dynamo at the Edgar Thomson Works of the Carnegie-Illinois Steel Corporation in about 1882. The arc lamps required considerable maintenance, and the light given off was anything but uniform in intensity, but this method of lighting was considered an improvement over gas lighting.

Later auxiliary motors were installed on a crane and roll tables.

While these installations were small their performance was sufficiently encouraging to extend the use of electrical equipment in the steel industry which equipment at first was installed largely to replace steam engine drive and now is being applied universally, chiefly to operate machinery in a manner which could not possibly be done with steam drive.

Considerable development has taken place in lighting alone for steel plants. Today we have special units for yard lighting, special units for general lighting of the mill, and another type of unit to use in lighting drafting rooms, machine shops, and points where careful inspection of material must be made. These various classes of lighting equipment have been brought to the point of development where steel plants can be operated on a 24 hour basis with little disadvantage to night operation.

Where steam drive was used it was often necessary to locate the boiler plant near the mill where the energy was to be utilized. Electrified plants permit the power to be generated near the source of fuel or at any other convenient place with little thought given to the location where the power will be used. The amount of power generated in the plant can be adjusted to the amount of fuel conveniently available. If additional power is required, the steel plant generating system can be paralleled with central station power.

Another example of the effect electrification has had on production methods is the change in method of rolling tin plate. The high speed continuous cold strip mills certainly would not be possible if we were required to rely upon steam engine drives.

The automatic screwdown operation of roll position, where as many as three sets of rolls are to be adjusted between passes is a good example of what is accomplished on auxiliary motor drives in a steel plant.

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Presented before Chicago Session of A. I. S. E. Annual Meeting, October 1, 1945.

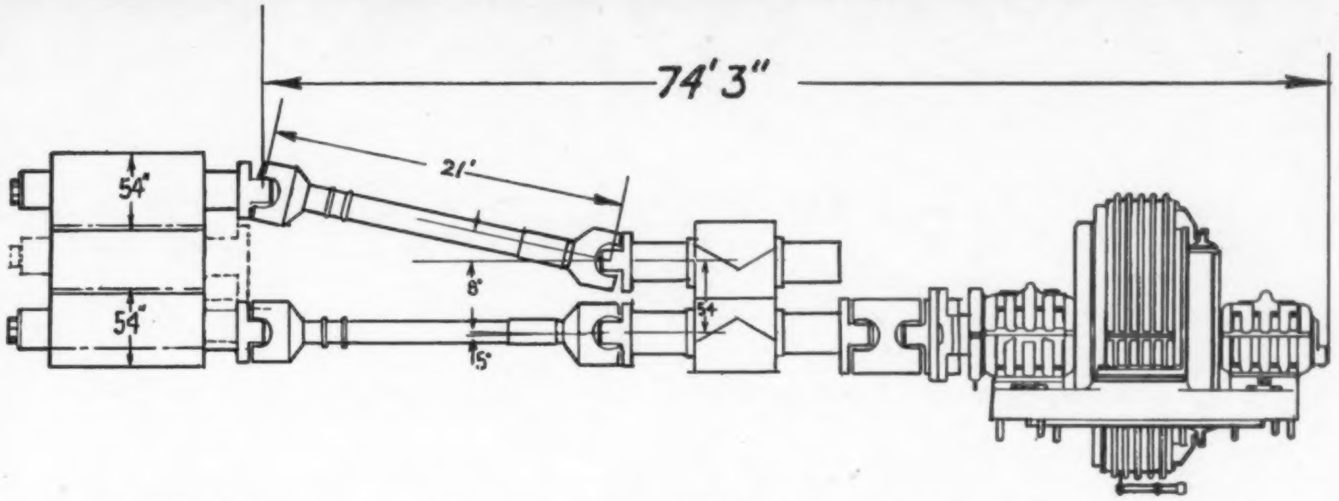


Figure 1 — General arrangement of 54 in. reversing blooming mill at Homestead driven by 8000 hp, 40-80 rpm motor.

While the record of development of electrical equipment and processes in the steel industry has been very impressive, there is still far more ahead than has been accomplished in the past.

Twin motor drive has developed into a modern method of improving the manufacture of steel. The first main roll drive installation using twin motors was made in 1930 on a 54 in. blooming mill at the South Chicago Works of the Carnegie-Illinois Steel Corporation. Recently there has been quite an increase in interest in the use of twin motor drive for various applications, so that a review of its development and possible uses may be appropriate.

This entire mill consisted of a 54 in. reversing blooming mill, a roughing Universal 52 in. reversing structural mill, an intermediate Universal reversing structural mill, and a finishing continuous running stand. In general, this entire mill was to be a substantial duplicate of such a mill previously installed at the Homestead plant of the Carnegie-Illinois Steel Corporation. One exception was that the motor on the 54 in. blooming mill was to be larger. The capacity of the motor at Homestead is 8000 hp with a base speed of 40 rpm. The new motor for the South Chicago mill was to be 10,000 hp at 40 rpm. The circuit breaker torque of such a motor is 3,600,000 ft lb, and the question arose as to the possibility of designing a satisfactory set of pinions for such a large mill. This led to consideration of the use of twin motor drive for this blooming mill which would eliminate the pinion housing. The problem, of course, was to design motors with small enough diameters to keep the angle of the vibrating spindles within satisfactory limits. It was first thought that the spindle driving the lower roll should be in a horizontal plane, and that the spindle driving the top roll would have to be kept within an angle that had proven satisfactory on existing mills. A check was made of the angle to which the upper spindle of the Homestead Mill operated, and in doing this it was found that the lower spindle operated at an angle rather than being in a horizontal plane. In this instance the diameter of the rolls was 54 in. when new, and the pitch diameter of the pinions was the same value. Since on a large slabbing mill the rolls are not brought together, this mill was designed to operate the lower spindle at a slope down from the bottom pinion to the bottom roll at an angle of 1½ degrees for a new roll and 1.1 degrees for an old roll.

The general arrangement of the pinion driven mill at Homestead is shown in Figure 1. The angularity of the vibrating spindles with old and new rolls is as follows:

**Pinion Driven Blooming Mill**
**Diameter of Rolls — 54 in.**
**Length of Vibrating Spindles — 252 in.**

| Condition | Distance, in. | Angle, degrees |
|---|---|---|
| Roll in extreme upper position — centerline new top roll above centerline top pinion | 35½ | 8 |
| Roll in extreme low position — centerline old top roll, below centerline top pinion | 8½ | 1.9 |
| Centerline of old bottom roll below centerline of bottom pinion | 5 | 1.1 |
| Centerline new bottom roll below centerline bottom pinion | 6½ | 1.5 |

With the upper roll in its extreme position, the opening between new rolls is 40½ in. Since heavy slabs are rolled on this blooming mill, the upper vibrating spindle is inclined at a fairly high degree most of the time. The maintenance of the couplings on this spindle is not serious, which served as a guide as to what could be used as a limit on the new mill with twin motor drive.

In addition to the diameter of the rolls and their separation, the length of the spindles between the rolls and the motors influences the angle of the vibrating spindles.

In laying out the new South Chicago blooming mill it was found that the length of the spindles could be conveniently increased from 21 ft to 25 ft, which in itself would reduce the angularity of the spindles. Also, since this would be the first installation of twin motor drive it was decided to use double armature motors to reduce the center distance between the motors, which would contribute to a reduction of spindle angularity.

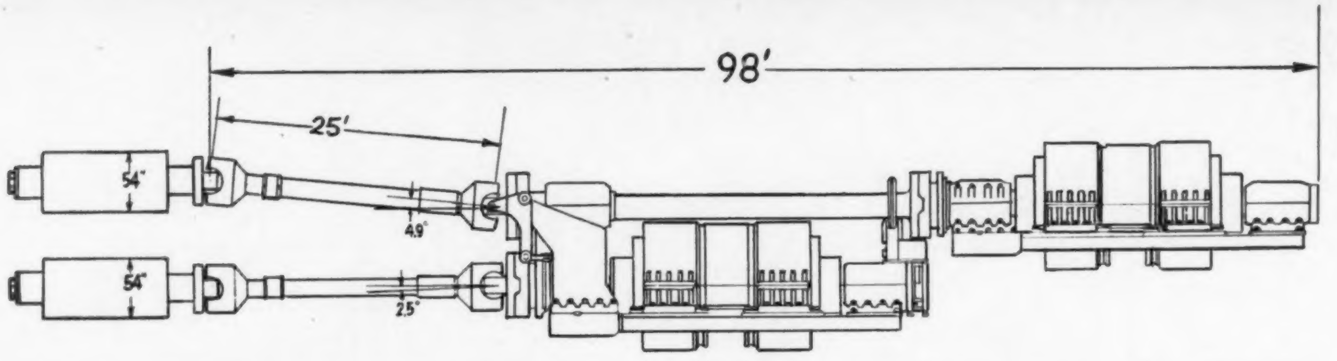
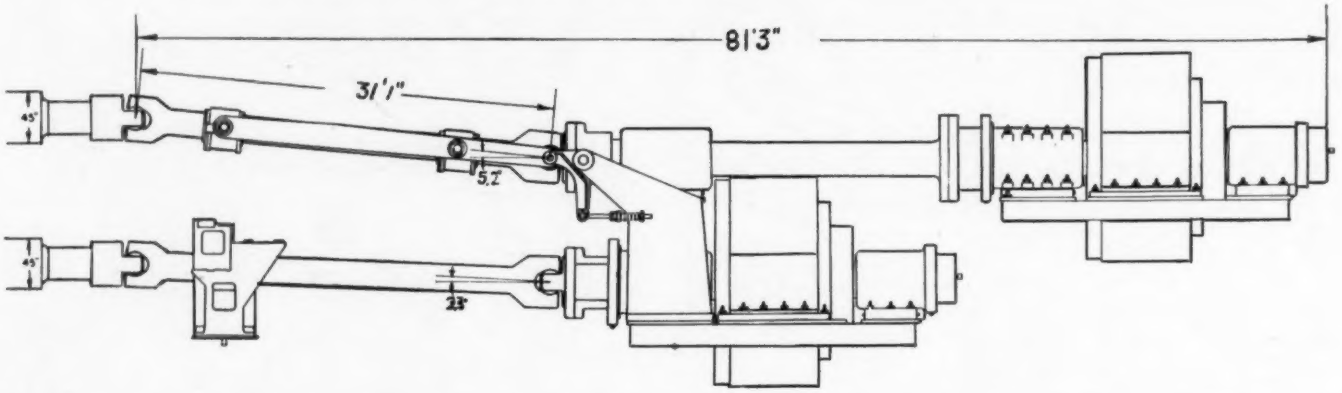


**Figure 2 — General arrangement of 54 in. reversing blooming mill at South Chicago driven by twin 5000 hp, 40-80 rpm double armature motors.** ↑

**Figure 3 — 45 in. Universal slabbing mill at the Edgar Thomson works driven by two 5000 hp, 40-80 rpm motors on horizontal rolls.** ↓



The final arrangement of this mill is shown in Figure 2 with resultant spindle angles given in the following table:

**Twin Motor Driven Blooming Mill**
**Diameter of Rolls — 54 in.**
**Length of Vibrating Spindles — 300 in.**

| Item | Distance, in. | Angle, degrees |
|---|---|---|
| Extreme upper position — centerline of top new roll above centerline top motor shaft | 26½ | 4.9 |
| Extreme low position — centerline old top roll below centerline of top motor shaft | 19½ | 3.7 |
| Centerline old bottom roll above centerline of bottom motor shaft | 16 | 3.0 |
| Centerline new bottom roll above centerline of bottom motor shaft | 13 | 2.5 |

It will be noted that the angularity of all these spindles in the positions given is greater than that of the bottom vibrating spindle on the Homestead pinion driven mill, but none of them are as great as 8 degrees obtained on the Homestead mill with a new roll in its extreme upper position. This resulted in a better balanced design.

This twin motor equipment has operated very satisfactorily since 1930 when it was first placed in operation. On a pinion driven mill using Universal couplings there are four places where backlash can develop between the motor and the bottom roll and five places between the motor and the upper roll. With the twin motor drive there are only two places in each case where backlash can develop, and they are in the Universal spindle bearings. Twin motor drives usually operate with less backlash and wear on rotating parts, and with the elimination of gears in the pinion housing the maintenance problem is less. In order to obtain a practical design of twin motor drive it is necessary to use small diameters so that the $WR^2$ of a twin motor drive is less than with the conventional pinion drive, which means that less heating is required to reverse the twin motor drive or with the same amount of accelerating and retarding current the motor can be reversed more rapidly.

A few months after the twin motor drive was purchased for the 54 in. blooming mill, this same plant came into the market for a Universal slabbing mill requiring the same capacity motors for the horizontal rolls. The equipment sold on the 54 in. blooming mill was duplicated for the horizontal rolls on the slabbing mill, and a 2500 hp reversing motor added to drive the vertical rolls. In addition to using crossed fields on the motors to make them develop the same torque, these first two units were installed with special synchronizing apparatus that would cause these motors to run at the same speed if the crossed fields did not prove effective. While this special synchronizing equipment was installed it was never used, and after a year's operation it was abandoned.

Our practice now is to rely entirely upon crossed fields. We do not try to make these motors run at the same speed, as this would require the same diameter of rolls. By causing them to divide the load, different diameter of rolls can be used if there is any reason for doing this.

The next twin motor drive to be installed was used to drive the 45 in. Universal slabbing mill at the Edgar Thomson Works of the Carnegie-Illinois Steel Corporation and is shown in Figure 3. This installation was made in 1938, and in certain respects a departure was made in a design of the twin motor drive from the two installed at the South Chicago works of the Carnegie-Illinois Steel Corporation.

The diameter of the rolls when new is 45 in. which is considerably smaller than the rolls used on the blooming mill at South Chicago. The design of the motors was simplified in that they were changed from double armature motors to single armature. By increasing the length of the spindles to 31 ft 1 in., their angularity was kept to substantially the same values as on the blooming mill twin motor drive at South Chicago. This is as shown in the following tabulation.

**Twin Motor Driven Slabbing Mill**
**Diameter of Rolls — 45 in.**
**Length of Vibrating Spindles — 373 in.**

| Item | Distance, in. | Angle, degrees |
|---|---|---|
| Extreme upper position — centerline of top new roll above centerline top motor shaft | 33¾ | 5.2 |
| Extreme low position — centerline old top roll below centerline of top motor shaft | 34¾ | 6.4 |
| Centerline old bottom roll above centerline of bottom motor shaft | 16⅜ | 2.5 |
| Centerline new bottom roll above centerline of bottom motor shaft | 14¾ | 2.3 |

Another change in design was the use of two thrust bearings on each motor instead of one as provided on the first two twin motor drives installed at South Chicago.

Where pinion drives are used it is expected that thrust on the mill will be taken by bearings on the pinion housing, and it is our practice to provide a thrust bearing on the mill end of the motor only to take thrust in case of a broken coupling between the motor and the pinion housing. When the twin motor drives were installed at South Chicago the question was raised as to whether it would be desirable to not only provide a thrust bearing on each motor next to the mill but also one on the pedestals away from the mill in order to take any pull that the mill might develop away from the motor. It was finally decided that the shoulder on the shaft would be sufficient. In general this is satisfactory, but some experience has been had where this pull has been great enough to justify more than simply a shoulder on the shaft. Starting with the Edgar Thomson twin motor installation, it has been our practice to install a thrust bearing at each end of each motor where there is no gearing so that thrust can be taken in either direction. Normally, the thrust bearings run free, but when thrust does occur the motor is designed to absorb a reasonable amount.

An item of interest in the installation of this type of drive is the comparison of overall length of the drive with that where a single armature motor is used with the conventional pinion housing. The following table gives the overall length from the outer extreme position of the motor shaft to the centerline of the Universal coupling on the shaft extension of the rolls. This information applies to the pinion driven blooming mill at Homestead, the twin double armature drive on the South Chicago blooming mill, and the single armature twin motor drive on the slabbing mill at the Edgar Thomson works.

| Mill | Overall length from outer motor shaft end to universal coupling of rolls |
|---|---|
| 54 in. pinion driven blooming mill single armature 8000 hp motor | 74 ft-3 in. |
| 54 in. double armature twin motor driven blooming mill, 10,000 hp | 98 ft-0 in. |
| 45 in. single armature twin motor slabbing mill, 10,000 hp | 81 ft-3 in. |

It is believed that every slabbing mill installed in this country since the South Chicago installation has been made with a twin motor drive. This attests to the very satisfactory operation of these large units.

The next new type of installation using a twin motor drive was that of the 160 in. 4-high reversing plate mill placed in operation in February, 1944 at the Homestead plant of the Carnegie-Illinois Steel Corporation. Previous to this installation, the conventional pinion drive has been used on such mills. The reasons for using a twin motor drive on this plate mill were not only to

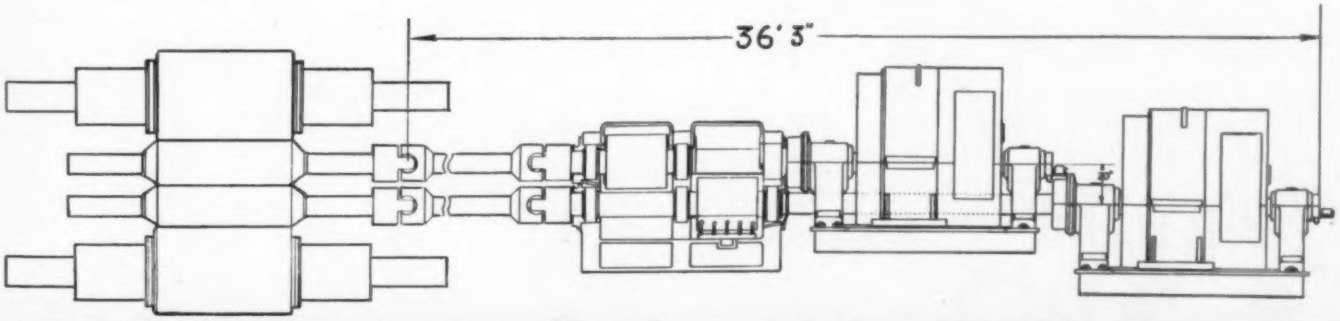


**Figure 4 — Twin motor drive for stand No. 3 of 56 in. 4-stand tandem cold sheet mill. Motors are 1500 hp, 200-450 rpm.**

take advantage of the general characteristics of a twin motor drive, but also to avoid pinion marking of the finished plate when the gears in the pinion housing are worn.

The diameter of the working rolls of the plate mill is 38 in., so that the problem of applying a 10,000 hp, 40 rpm twin motor drive was not particularly different from that of applying such a drive to a 45 in. Universal slabbing mill.

There was some concern as to the possibility of one motor running faster than the other which might cause the plate to either incline down into the table or up into the air as it left the mill. After the mill was in operation for some period, a test was made to determine what effect unbalance of load on the two motors would have on causing the plate to leave the mill in a plane other than one substantially horizontal. The fields of the two motors were adjusted so that one motor took 25 per cent more load than the other. In spite of this difference in torque produced by the motors, the plate being rolled came out of the mill the same as with normal field adjustment on the motors.

The low $WR^2$ of the motor armatures, the limiting of backlash to that which would be developed in the Universal couplings, a reduction in maintenance and the total absence of pinion marking of the finished plate, constitute the chief advantages this type of drive has over the conventional pinion drive.

The very satisfactory operation of the large blooming and slabbing mill drives, as well as that on the plate mill, will influence steel manufacturers to use twin motor drives not only on mills of the type where the twin motor drive is already used, but on other types. We are already building twin motor drives for tandem cold sheet and tin plate mills. Its introduction to a tandem cold mill was made by the Bethlehem Steel Company at Sparrows Point where direct connected pinion drive motors are to be used on stands No. 1 and 2 and twin motor drives with offsetting gears will be used to individually drive the upper and lower working rolls on stands No. 3 and 4, of a four stand 56 in. sheet mill. The arrangement of the twin motor drives on the last two stands of this mill is shown in Figure 4.

A similar application is being used on a 5-stand tandem tin plate mill to be installed by the Weirton Steel Company. The first three stands are to be driven by direct connected motors with pinion housing, and the last two stands will be driven by twin motor drives through offsetting gears as shown in Figure 4. The prime reason for using twin motor drives on the finishing stands is different from that where a twin motor drive is used for a large blooming, slabbing or plate mill. Continuous cold strip mills are being installed at such high delivery speeds that it becomes very important to keep the peripheral speed of the upper and lower working rolls the same at all times. The thickness of the metal in these finishing stands is very small, and the metal becomes brittle by the time it reaches the delivery end of the mill.

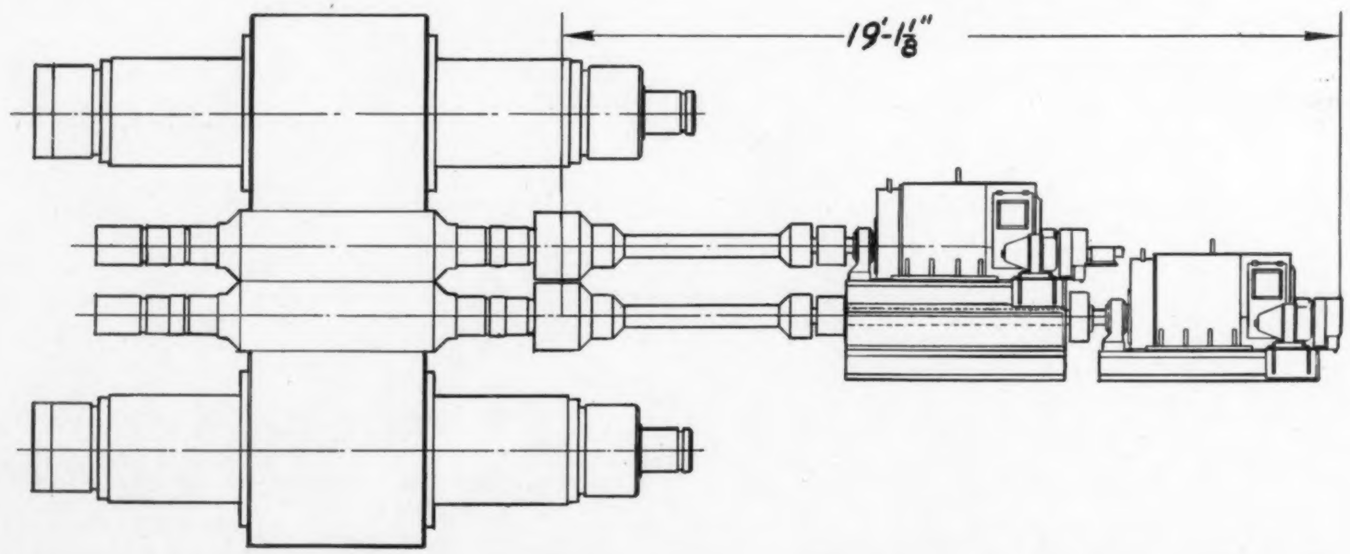
On the finishing end of a mill rolling thin gauges there is considerable pressure between rolls even with no metal in the mill. With any difference in working roll diameter on a pinion driven mill this would make the rolls grind each other and cause their surfaces to become rough. This is avoided with separate roll drives.

On the Bethlehem mill the offsetting gears are so designed that they have the same ratio on stand No. 3 as they do on stand No. 4. The driving motors are selected for an intermediate speed and the speed is stepped down for stand No. 3 and stepped up for stand No. 4 simply by reversing the gears in the housing. This permits duplication of gears on the two stands.

On the Weirton mill step-up gears of different ratios are used on both the last two stands, which made it possible to use single armature motors to drive each roll instead of double armatures.

Bethlehem are initiating the use of twin motors on

**Figure 5 — Twin drive on temper pass mill with special designed motor which eliminates offsetting gears. Motors are 200 hp, 600-750 rpm.**



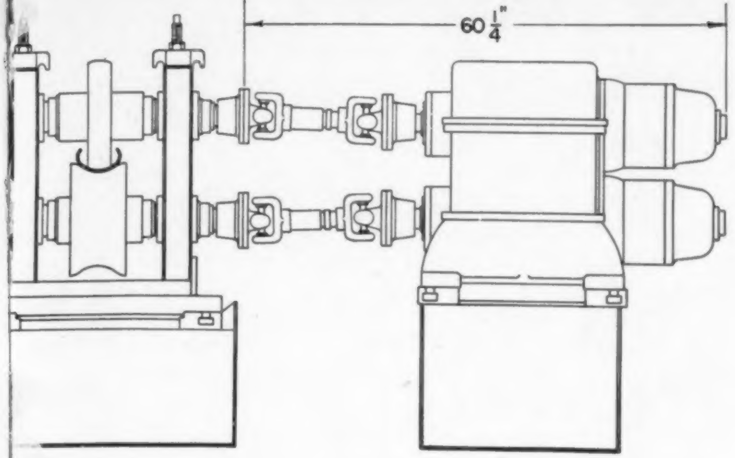
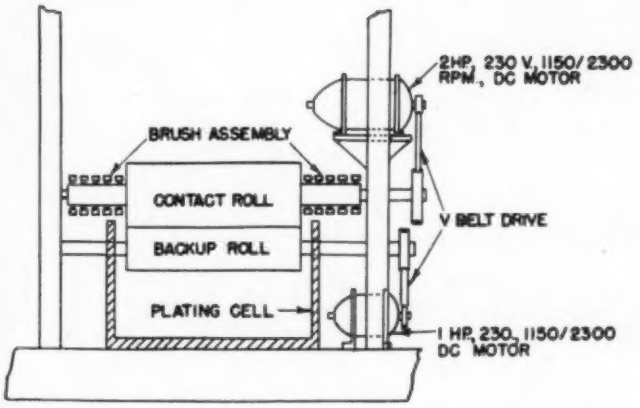


**Figure 6 — Tube forming mill consisting of geared, twin motor drive with two 1½ hp, 1150-1450 rpm motors.**

**Figure 7 — Single armature belted twin motor drive used on electrolytic line. Top motor is 2 hp, 1150-2300 rpm and bottom motor is 1 hp, 1150-2300 rpm.**


2HP, 230 V, 1150/2300 RPM, DC MOTOR
BRUSH ASSEMBLY
CONTACT ROLL
BACKUP ROLL
PLATING CELL
V BELT DRIVE
1 HP, 230, 1150/2300 DC MOTOR

the main drive of four-high temper pass mills. The Sparrows Point plant is installing two new temper pass mills; the working rolls of each will be driven by separate motors. The power required to drive this mill is only 400 hp, and by making a special designed motor we were able to eliminate the offsetting gears and connect the motor armatures direct to the working rolls without introducing any particular angularity in the driving spindles. This is important as the maximum delivery speed of these two mills is 3300 fpm. It is felt that this twin motor drive will have considerable advantage on a skin pass mill where the rolls are run dry, as the motors will adjust their speed to avoid running the rolls at different linear velocities either with the metal in the rolls or when the mill is running idle with the rolls screwed tightly together.

Figure 5 shows the outline of the special motor designed for the temper pass mills with reduced diameter to avoid the use of offsetting gears.

Still another type of application for a twin motor drive is being made on the forming rolls of a tube mill. In this case we have used individual gearmotors to drive the top and bottom rolls separately. The reason for this is that in forming skelp into pipe the pitch diameter of the roll varies as the skelp takes its cylindrical shape. This is true due to variation in size of pipe formed and also due to the fact that the pitch diameter of the top and bottom roll of a given stand may differ. The motors are designed to adjust themselves to various differences in pitch diameter of the rolls. Figure 6 is a typical arrangement of this type of drive.

Another application for a twin motor drive is the use of individual motors to drive the top and bottom roll on an electrolytic tinplating line as shown in Figure 7. It is important not to scratch the surface of the strip, particularly after it has been plated. On such a line if a pair of rolls are geared to each other, it is essential that they be kept at exactly the same peripheral speed otherwise any difference in speed will scratch the tin plate. To avoid any possibility of doing this, we have made an installation where the motors used to drive the plating rolls are installed in pairs, one to drive the upper roll only and the other the lower roll. These motors are direct current and designed with a heavy dropping speed characteristic so that they will slow down if one should tend to operate faster than the other rather than slip the roll on the metal. These have worked out very satisfactorily and eliminate the argument that the rolls may be scratching the tin plate.

Twin motor drive is a typical example of a development where one or two initial units are installed and operated for a period of years and then slowly other installations are made until there has been enough experience in the field to refine its design and see what its real advantages and uses are. This development was unusual in that the first installation was such a large unit, and considerable credit is due the Carnegie-Illinois Steel Corporation for their courage in making the first installation. Actually they purchased two units before any field experience was had. Like many other new devices when the first installation is considered we do not appreciate all the possibilities, but there is every indication now that the twin motor drive will find a number of uses in the steel industry and will assist in making a better product with less maintenance than would otherwise be obtained.

**DESIGNERS WANTED:**

First Class Designers on medium and heavy machinery. Must be experienced on rolling mill machinery and allied products. In reply state age, experience in full, education and salary expected.

**TREADWELL ENGINEERING COMPANY**
**EASTON, PA.**

# THE SPRAYING OF *Gear Lubricants*

***. . . . the development of new types of greases has made possible their application by spraying, giving an improved method of lubrication for open gearing . . . .***

*by D. E. Whitehead,* LUBRICATION ENGINEER

CARNEGIE-ILLINOIS STEEL CORPORATION

PITTSBURGH, PENNSYLVANIA

▲ THE spraying of gear lubricants has become a subject of increased importance in recent years. Until a few years ago, the application of lubricants to gears by spraying was confined to fluid oils. It is now possible to spray extremely plastic greases.

The question of when to spray and when not to spray lubricants, fluid or plastic, requires careful deliberation.

The more recent substantial developments in lubricants and lubricating equipment further complicate spray adaptation and make it additionally imperative that the design and lubrication engineer closely confer in the development of new industrial equipment.

The complex piping and devices constituting the installation of the fluid spray system for various gear drives, particularly mill table gearing, complicates maintenance operations and may, considering the abilities of modern extreme pressure or multifunctional lubricants, be entirely unnecessary.

Some impressive data have been recently obtained regarding the proper volume and delivery pressure for lubricating oils to higher speed reduction gears, which illustrates the bad features of overfeeding. In addition, considerable constructive thinking is being directed toward alleviating problems through fortifying the lubricant rather than attempting to accomplish perfection through lubrication methods in the cases of a variety of precision drives.

In applications embracing wet (water) conditions or substantial intrinsic and extrinsic solids contamination or both, the development of more effective lubricant filtering devices and chemical demulsifying additives has rendered the use of the fluid lubricant spray, as an integral part of the system, a less hazardous function.

This has been done repeatedly in applications involving the use of some of the more elementary types of mill equipment, but the use of chemical demulsifying agents to facilitate positive operation of sprays in turbine lubricant maintenance has received little acceptance in spite of the fact that demulsibility is the crucial factor in the life of the lubricant.

The spraying of fluid oils in future practice, as an

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Presented before the Pittsburgh and Philadelphia, Pennsylvania Sessions of the Annual Meeting on September 26 and October 6, 1945, respectively.

integral part of enclosed gear lubrication, will be greatly influenced by developments in lubricants themselves. Altogether, lubrication of the enclosed gear has been better engineered, through a greater selection of better adapted methods, than we find in the case of the open type gear.

The satisfactory application of an effective and enduring lubricant to "open type gearing" is an old and familiar problem. This belief is substantiated by the fact that any mention of this subject before an engineering or maintenance group of individuals of any age will arouse an abundance of ardently seasoned prejudices and cause them to be expressed without reluctance. Despite the fact that more collective energy has been expended in the pursuit of a solution to this problem than probably any other phase of mill lubrication, the progress made has not been satisfying.

The accelerated production and product development requirements of the war upon industry imposed excessive service demands upon existing industrial gearing, with the result that borderline gear lubrication was transposed into gear failure. Increases in tooth loading, shock, speed, temperature, and continuity of service disclosed a multitude of manifestations of a needed safety factor in gear lubricants.

Had the use of "open gearing" been perpetuated to an appreciable extent in the design of modern industrial machinery, with the parallel development of better lubricants stressed as an issue, a resulting larger measure of progress might have been attained. Conversely, interest in the subject of open gear lubrication has been badly neglected through the prevailing attitude toward the "obsolete" open gear. Just how "obsolete" the open gear is, or will be for some time to come, might constitute a difficult appraisal. Apart from the millions of currently operating "open gears" ultimately destined for obsolescence, but in the meantime requiring lubrication and accruing high maintenance cost figures, there are and will be vast numbers that do not lend themselves to oil tight enclosures through irregularities in their function.

Most of the gearing in equipment of recent design is enclosed by oil tight cases or cases intended to be oil tight. The lubricating oils employed in most instances were developed to be adequate for the service intended.

Despite the ready availability of choice multifunctional, high safety factor lubricants and in total disregard of the safety factor established by the designers for the unit of equipment itself, the popular tendency still prevails to select lubricants having no safety factor. This same thinking reverts to the lubrication of "open gearing" and perpetuates a like tolerance to inefficiency.

In recent years the practice of spraying lubricants on "open gearing" has increased in popularity. This development embraces two general methods of spray delivery. The earliest development, and probably the most popular, closely duplicates a conventional paint spray gun, utilizing air for priming the grease to the spray nozzle and also for the propelling or delivery air blast. Quite viscous greases are delivered to the gears in fully controlled spray patterns. The second method embodies the delivery of a liquified stream of grease forced by air actuated mechanical pressure through a controlled orifice located in the spray nozzle.

Some compromise is necessary in either of these methods of spray gun application. The units, which are sufficiently portable, have grease capacity limitations of from three to five pounds. The grease reservoir and nozzle are mounted together in a compact unit and are carried by the operator who has only a one-half inch air line to drag. The units having a grease capacity of from 25 to 400 pounds forfeit any liberal aspects of portability. The limitations in flexibility ascribed to the various types of grease spray guns will restrict their general use for open gear application. The necessity of providing air outlets and the rigging, handling, loading, and storing of the spray guns causes some deliberation attending their use.

The outstanding service rendered by the grease spray gun in many gear applications in which their use has substantially increased gear life during the stress of war has certified their use in certain applications as advantageous. The fact is also being repeatedly demonstrated that the grease spray gun, when used with lubricants specifically developed for spray application, is far more efficient than any other method of lubricating "open gears" developed to date. The required frequency of application is substantially reduced while the load carrying capacity of the lubricant has been materially increased.

Most of the lubricants developed for use in the grease spray gun are of the extreme pressure type. This means an advantage of approximately five to seven times the protection provided by a non-additive type lubricant in load carrying capacity. The multifunctional advantages of this type extreme pressure lubricant are many, dependent to some extent upon the nature of the additives employed. Among the wide scope of advantages gained through the utilization of the spray application and spray lubricants as compared to the common practice of applying residual petroleum lubricants (gearshield) to gears by swabbing or pouring, are the following:

1. *High anti-weld value* — Enduring anti-weld qualities are more difficult to attain in spray application. The long interval between lubricant replenishment coupled with the diminishing film requires unusual quality of fortification in the lubricant additive.

2. *High film strength, lubricity, or oiliness value* — These factors would vary according to the composition of the additives employed in a specific lubricant though, generally, most of all these values and their respective benefits will be found in the leading spray gun lubricants.

3. *Good metal wetting ability* — Spray gun lubricants have been developed for maximum metal adhesiveness under duress of high rubbing pressures. Wetting ability and metal adhesiveness are closely associated in effecting good thin film lubrication.

4. *Full protective value without excessive coverage* — Since the use of extreme pressure lubricants, incorporating chemically active thin film lubrication, precludes the necessity of the functioning of a fluid or hydrodynamic film, the piling on of excess lubricant is futile in spray application. It is initially difficult to accustom mill lubrication personnel to thin film operation, but intimate contact and observation rapidly satisfies any apprehensions.

5. *Less retention of contaminants upon tooth surfaces* —

Heavy petroleum residuals or similar materials do function as binders and imbed abrasive materials that are re-worked upon contacting tooth surfaces to the depreciation of these surfaces. Conversely, thin film lubrication holds a decided advantage in this regard.

6. *Uniform operating characteristics independent of atmospheric temperature* — The thin film operating characteristics of the spray gun lubricants render the film almost impervious to atmospheric temperature consistency problems.

## TABLE I

**Timken Machine Tests Using Bronze Test Block**

A 1000 sec oil, calcium base grease containing lead oleate and chlorine.
Lever arm weights......25 lb Scar width............0.1893
Lever arm weights......33 lb Scar width............0.2518

Temperature

| Minutes | Lever arm 25 lb | Lever arm 33 lb |
|---|---|---|
| 1 | 167 F | 167 F |
| 2 | 194 F | 203 F |
| 3 | 212 F | 221 F |
| 4 | 230 F | 230 F |
| 5 | 230 F | 239 F |
| 6 | 239 F | 248 F |
| 7 | 239 F | 248 F |
| 8 | 248 F | 257 F |
| 9 | 248 F | 257 F |
| 10 | 248 F | 257 F |

A 1200 sec oil, calcium base grease containing paratak.
Lever arm weights......25 lb Scar width............0.1555
Lever arm weights......33 lb Scar width............0.2120

Temperature

| Minutes | Lever arm 25 lb | Lever arm 33 lb |
|---|---|---|
| 1 | 140 F | 167 F |
| 2 | 158 F | 203 F |
| 3 | 182 F | 212 F |
| 4 | 212 F | 230 F |
| 5 | 239 F | 248 F |
| 6 | 257 F | 257 F |
| 7 | 257 F | 266 F |
| 8 | 257 F | 284 F |
| 9 | 257 F | 284 F |
| 10 | 257 F | 284 F |

Note: Temperature was obtained by inserting a thermocouple into the drilled bronze test block.

A 1500 vis. leaded gear oil (lead naphthanate, no add. sulphur)
Lever arm ............ 5 lb Scar width.........0.080 in.
Lever arm ............ 12 lb Scar width.........0.065 in.
Lever arm ............ 18 lb Scar width.........0.125 in.

A 2400 vis. bright stock (no additives)
Lever arm ............ 5 lb Scar width.........0.0893 in.
Lever arm ............ 12 lb Scar width.........0.1112 in.
Lever arm ............ 18 lb Scar width.........0.2131 in.

## TABLE II

| | Grease 1 900 Sec oil Calcium soap 10% Lead naphsul sperm | Grease 2 1000 Sec oil-calc. 8% Lead oleate-chlorine plus paratak | Grease 3 All purpose type 1100 Sec oil lead naph | Grease 4 1000 Sec oil Calcium soap plus paratak-1% | Grease 5 1200 Sec oil Calcium soap 1-2% Paratak | Grease 6 1000 Vis. oil Calcium soap |
|---|---|---|---|---|---|---|
| Bronze No. 1 Test Block | 18 lb L.A. Timken<br>Temp—185 F<br>Scar—0.08 in. | 18 lb L.A. Timken<br>Temp—104 F<br>Scar—0.083 in. | 18 lb L.A. Timken<br>Temp—185 F<br>Scar—0.083 in. | 18 lb L.A. Timken<br>Temp—113 F<br>Scar—0.087 in. | 18 lb L.A. Timken<br>Temp—194 F<br>Scar—0.091 in. | 18 lb L.A. Timken<br>Temp—203 F<br>Scar—0.109 in. |
| | 33 lb L.A. Timken<br>Temp—221 F<br>Scar—0.122 in. | 33 lb L.A. Timken<br>Temp—266 F<br>Scar—0.208 in. | 33 lb L.A. Timken<br>Temp—239 F<br>Scar—0.158 in. | 33 lb L.A. Timken<br>Temp—275 F<br>Scar—0.174 in. | 33 lb L.A. Timken<br>Temp—285 F<br>Scar—0.180 in. | 33 lb L.A. Timken<br>Temp—302 F<br>Scar—0.205 in. |
| Bronze No. 2 Test Block | 18 lb L.A. Timken<br>Temp—113 F<br>Scar—0.075 in. | 18 lb L.A. Timken<br>Temp—104 F<br>Scar—0.095 in. | 18 lb L.A. Timken<br>Temp—176 F<br>Scar—0.122 in. | 18 lb L.A. Timken<br>Temp—104 F<br>Scar—0.123 in. | 18 lb L.A. Timken<br>Temp—185 F<br>Scar—0.141 in. | 18 lb L.A. Timken<br>Temp—194 F<br>Scar—0.147 in. |
| | 33 lb L.A. Timken<br>Temp—212 F<br>Scar—0.148 in. | 33 lb L.A. Timken<br>Temp—220 F<br>Scar—0.248 in. | 33 lb L.A. Timken<br>Temp—257 F<br>Scar—0.248 in. | 33 lb L.A. Timken<br>Temp—266 F<br>Scar—0.238 in. | 33 lb L.A. Timken<br>Temp—266 F<br>Scar—0.189 in. | 33 lb L.A. Timken<br>Temp—248 F<br>Scar—0.250 in. |
| Tin Base Babbitt Test Block | 18 lb L.A. Timken<br>Temp—112 F<br>Scar—0.106 in. | 18 lb L.A. Timken<br>Temp—104 F<br>Scar—0.147 in. | 18 lb L.A. Timken<br>Temp—140 F<br>Scar—0.229 in. | 18 lb L.A. Timken<br>Temp—112 F<br>Scar—0.149 in. | 18 lb L.A. Timken<br>Temp—104 F<br>Scar—0.167 in. | 18 lb L.A. Timken<br>Temp—158 F<br>Scar—0.267 in. |
| | 33 lb L.A. Timken<br>Temp—140 F<br>Scar—0.218 in. | 33 lb L.A. Timken<br>Temp—176 F<br>Scar—0.194 in. | 33 lb L.A. Timken<br>Temp—176 F<br>Scar—0.377 in. | 33 lb L.A. Timken<br>Temp—122 F<br>Scar—0.179 in. | 33 lb L.A. Timken<br>Temp—149 F<br>Scar—0.250 in. | 33 lb L.A. Timken<br>Temp—230 F<br>Scar—0.353 in. |
| Lead Base Babbitt Test Block | 18 lb L.A. Timken<br>Temp—104 F<br>Scar—0.152 in. | 18 lb L.A. Timken<br>Temp—104 F<br>Scar—0.147 in. | 18 lb L.A. Timken<br>Temp—104 F<br>Scar—0.190 in. | 18 lb L.A. Timken<br>Temp—112 F<br>Scar—0.126 in. | 18 lb L.A. Timken<br>Temp—112 F<br>Scar—0.116 in. | 18 lb L.A. Timken<br>Temp—112 F<br>Scar—0.239 in. |
| | 33 lb L.A. Timken<br>Temp—122 F<br>Scar—0.213 in. | 33 lb L.A. Timken<br>Temp—112 F<br>Scar—0.194 in. | 33 lb L.A. Timken<br>Temp—122 F<br>Scar—0.242 in. | 33 lb L.A. Timken<br>Temp—122 F<br>Scar—0.178 in. | 33 lb L.A. Timken<br>Temp—131 F<br>Scar—0.247 in. | 33 lb L.A. Timken<br>Temp—203 F<br>Scar—0.337 in. |

Each test of ten minute duration only employing Timken machine standard test procedure.

7. *Reduced power consumption* — We are all too familiar with the substantial opposition to motion imparted, particularly during low temperature operation, by the petroleum residual lubricants. Under some conditions operation of a unit is impossible until expensive temperature corrective measures have been taken. In all events, there is an unwarranted waste of power. These wasteful conditions are non-existant when thin film lubrication is utilized. It would be interesting to develop actual power saving possibilities in this regard in a large industrial plant.

8. *Less frequent application of lubricant* — As previously stated, there is no advantage gained by maintaining a heavy or dense application of the spray gun lubricant upon gear surfaces. A thin coating will survive for surprisingly long intervals. Reports of actual tests show maintaining intervals are from four to twenty times as long as those necessary for equal protection by residual petroleum lubricants. While procurement cost of the spray gun greases is somewhat higher than residual materials, the less frequent applications necessary permit a lower lubrication cost on the part of the spray gun greases since labor is a large factor.

Definite progress has been established in the methods of applying "open gear" lubricants, but this progress has been confined to developments in the specialized form of spraying and there are limitations to this method. Spraying may be augmented by other methods of applying these lubricants of outstanding merit that have been developed primarily for the spray gun. In some applications where spraying may not be well adapted, consideration can be given to the automatic or manually operated centralized greasing systems that have been developed for complete lubrication coverage. Bearing coverage is generally engineered to the complete exclusion of those integral occasional gears.

There are abundant opportunities to employ those same centralized grease systems exclusively for gear lubrication. Grease spray guns are generally thought of as a portable method of applying lubricants. It would appear reasonable that small units having adequate grease capacity could be permanently affixed to certain critical gear trains, the spray interrupted by one of many available time clocks developed for grease equipment.

There are also currently available several moderate capacity, foot and hand operated grease pumps to which a portion of a centralized grease system could be attached which in turn could lubricate from one to several dozen gears and bearings on a great variety of units of industrial equipment.

Perhaps it is because the early types of lubricants employed for gear lubrication have not and could not be used as bearing lubricants that the development of lubricating equipment for common application has been retarded, thus causing manufacturers of lubricating equipment to be not fully aware that there are now such splendid opportunities for improved equipment.

With the sufficient activity aroused in the use of centralized grease systems for dispensing gear lubricants, new developments can be expected in further improvement in fortified greases. It should not be necessary to create lubricants to facilitate their operation in the centralized systems at the expense of their performance as gear lubricants.

## TABLE III

**Specifications of Bronze Used in Tests Described in Table I**

| | Per cent |
|---|---|
| Cu | 83.10 |
| Sn | 8.97 |
| Pb | 6.85 |
| Zn | 0.42 |
| Ni | 0.34 |
| Fe | 0.017 |
| S | 0.02 |
| P | 0.44 |

**Specifications of Bearing Test Blocks Employed in Tests in Table II**

**Bronze No. 1**

| | Per cent |
|---|---|
| Cu | 83.10 |
| Sn | 8.97 |
| Pb | 6.85 |
| Zn | 0.42 |
| Ni | 0.34 |
| Fe | 0.017 |
| S | 0.02 |
| P | 0.44 |

**Bronze No. 2**

| | Per cent |
|---|---|
| Cu | 80.00 |
| Pb | 10.00 |
| Sn | 9.00 |

**Tin base babbitt**

| | Per cent |
|---|---|
| Sn | 87.50 |
| Sb | 7.50 |
| Cu | 4.50 |
| Ni | 0.40 |
| Te | 0.10 |

**Lead base babbitt**

| | Per cent |
|---|---|
| Pb | 80.60 |
| Sb | 16.50 |
| Sn | 1.25 |
| As | 1.25 |
| Cu | 0.40 |

More emphasis should be placed on the excellent adaptability of the spray gun lubricants for bearing application and the types of bearings for which these lubricants are adaptable. A specific laboratory program was developed to permit study of the influence of various lubricant film fortifying additives in reducing wear in bearing applications of bronze to steel or babbitt to steel bearing applications. Definite correlation was found between test block temperature, measurable test block wear rate and the fortification of the lubricants by addition of various indicated additives. These additives were known to have value in steel to steel application of lubricants. The value of this program was in verifying their application in bronze or babbitt to steel. The lubricant additives employed included lead (naphthanate and oleate), sulfur (in combined forms), chlorine, phosphorous, paratac, latex, graphite, and mica alone and in combination.

The attached Table I and Table II disclose some of the tests performed, utilizing bronze and babbitt test blocks, the compositions of which are listed in Table III. The Timken test machine was employed, using the standard grease test procedure.

Lever arm loading of the Timken machine was not high and the test duration was held to ten minutes as indicated on the chart shown in Table I.

Laboratory test programs of this nature, while not capable of conclusively proving mill operating values of lubricants have been consistently valuable in guiding improvements that have been confirmed in mill operations. The surprising revelations of this test were first established under mill operating conditions where high bronze bearing temperatures existed. These high temperatures were reduced by the simple expedient of utilizing lubricant additives prescribed in the laboratory.

The higher melting points (A. S. T. M. dropping point), higher load carrying values and smooth texture, combined with good metal adhesiveness characteristics ideally suits the spray gun lubricant for most any moderate or slow speed bronze, or babbitt, to steel bearing application. Where water conditions, extreme temperatures or speeds are encountered other lubricants may be better qualified.

In the case of anti-friction bearings the specifications of the specific spray gun lubrication would be of more moment. Fillers employed in the lubricant such as mica, graphite, etc., may cause disqualification of the lubricant, but generally, except in the case of high speeds, the spray gun lubricant would perform more satisfactorily than simple soda or calcium base greases commonly used.

If a spray gun grease is marketed by a supplier whose sole consideration in the development of the product was directed toward gear lubrication, the responsibility of proving the anti-friction bearing corrosion, abrasiveness, and oxidation stability would be inherited by the consumer. Cross contamination of bearing and gear lubricant has been an important problem in connection with a wide assortment of gear drives. Closer cooperation between the design and lubrication engineer in consideration of all modern possibilities in lubricants and lubricating devices could ease such problems.

As the alchemist persistently searched for the key to the transmutations of metals with almost equal persistance and undoubtedly with very similar technique, so has the mill oiler searched for the open gear lubricant that he could pour on, swab on, spray on, or throw on with the least effort. Some of the new spray gun lubricants come remarkably close to fulfilling that requisite. Perhaps a little more collective thinking and effort expended in the interest of the not-yet-extinct "open gear" and in the salvation of the mill oiler may cause development of such a lubricant or a new method of application that would make all gear lubrication simple.

*Annual Spring Conference*

SPONSORED BY THE

ROLLING MILL COMMITTEE

OF THE

Association of Iron and Steel Engineers

MONDAY and TUESDAY

MAY 6 - 7

CONGRESS HOTEL CHICAGO, ILL.

## DISCUSSION

PRESENTED BY

C. R. HAND, Lubrication Engineer, Bethlehem Steel Company, Sparrows Point, Maryland

MAURICE RESWICK, Lubrication Engineer, Standard Oil Company of New Jersey, Pittsburgh, Pennsylvania

**C. R. Hand:** Mr. Whitehead has given a good account of what has been done to get better open gear lubrication. Lubricants can be more readily applied to most open gears by spraying than by any other method. However, there are some places where the equipment necessary to create the spray is the principal objection, and carrying a spray outfit up a ladder to get to crane gears is a case in particular. On table gears and other gears located at ground level, this method is to be preferred. There is a place for improved open gear lubrication in all plants.

**M. Reswick:** The highlight of Mr. Whitehead's paper is the emphasis on the difference between the old type gear shields and the new types of plastic greases for gear lubrication. We are all familiar with the properties of these gear shields. First you have to heat them and then you pour them on the gears by hand. On cold mornings the lubricant sets up so hard that starting is difficult without kicking out the circuit breakers.

Mr. Whitehead describes the latest application of plastic greases, the advantage being that they adhere to the gears and instead of hardening and pushing off as the gears engage they spread evenly over the tooth surface. In other words, these plastic greases supply the necessary lubricating film on the gear teeth in place of the heavy carpet-like coating of the old type lubricants.

# *Applying Fluid Drive* IN INDUSTRY

***. . . . fluid drive is well known in the automobile field where it has had much publicity . . . . though not so common in the steel industry, its applications are nevertheless numerous . . . .***

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▲ THE machinery of all industry requires for its operation some form of power. The successful application of power to this machinery is necessary. It is the purpose of this paper to discuss the transmission of power through fluid drive.

There are two distinct hydraulic methods of power transmission which must first be recognized. The hydrostatic method depends for its operation on positive displacement pumps and oil motors. The hydro-kinetic method depends on the release onto a turbine section, energy stored in a transmitting fluid by impeller action. This discussion is confined to the hydro-kinetic type of unit.

The designations, "hydraulic coupling" and "fluid drive," are both used in this paper. Both apply to the same unit. The marine unit and variable speed units are probably best known by the name, "hydraulic coupling," because of past usage by those who have been concerned with their application. The name, "fluid drive" has been prominently used for the self-contained sealed unit on internal combustion engine applications and is being retained.

## HISTORY

Transmission of power by means of the hydro-kinetic machine dates back to the turn of the century and the "Fottinger Speed Transformer" invented by Dr. Fottinger. This idea was conceived in order that relatively high speed efficient prime movers and slow speed efficient propellers could be utilized for ship propulsion. The speed transformer was made up of primary and secondary vaned rotating members with interposed stationary vaned reaction members which redirected the flow of fluid. The result was torque multiplication at reduced speeds of the output shaft. This unit provided speed reduction and torque multiplication in the range of 5 to 1 at an efficiency of approximately 85 per cent. With the development of the very efficient Parson's reduction gear, further application of the Fottinger speed transformer was limited.

The necessity for a fluid unit of a two element type which would transmit torque of a 1 to 1 ratio at high efficiency and relieve torsional vibrations became apparent with the development of the diesel and reduction gear for ship propulsion. This development was carried on by Dr. Bauer who perfected the two element unit.

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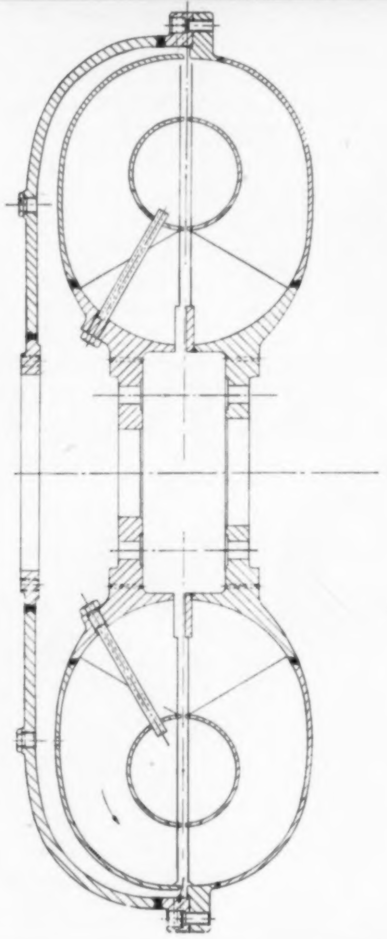


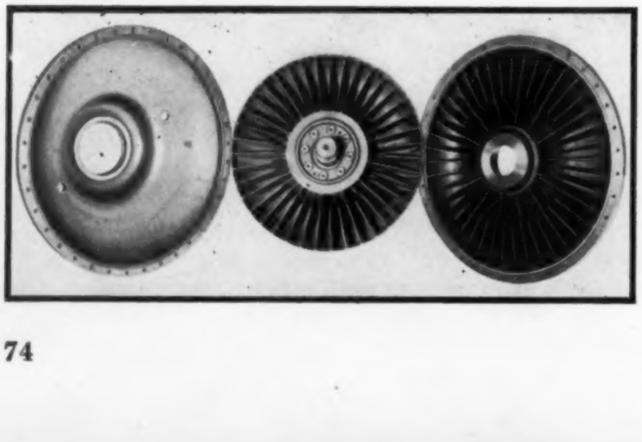
Figure 1 — Section showing three basic elements of fluid drive.

The year 1924 saw the first diesel ship to sail with the combination of diesel engine, hydraulic coupling and reduction gear.

Credit for the start of the development of the hydraulic coupling into the traction and variable speed units for industrial use goes to Harold Sinclair, of Isleworth, England. His work began in 1928. American participation began in 1932 when the writer's company acquired the patents and exclusive manufacturing rights to produce and sell this article in North America.

This paper will be concerned with the two element type of fluid drive unit known commonly by the name, hydraulic coupling. Basically, the hydraulic coupling consists of three elements. Figure 1 shows the impeller or primary rotor facing the runner or secondary rotor.

Figure 2 — Photograph of the primary and secondary rotor and outer casing.



The function of the outer casing, which normally rotates with the impeller is to form a chamber with the impeller and thereby confine the transmitting fluid to the working circuit. Figure 2 is a photograph of the three elements. From the three basic elements, three designs of power transmitting units have been evolved. These are marine, traction, and variable speed.

The hydraulic coupling is a simple machine. Both the impeller and runner elements consist of a retaining wall or shell to which is attached a series of radial vanes. The vanes are at right angles to the back wall of the shell and have no curvature. The plane of each vane, if extended, would include the shaft center line. In assembly, there is no mechanical connection between the impeller and runner. Power is transmitted by a fluid which circulates from impeller to runner. The transmitting fluid gains kinetic energy by centrifugal pump action as it is forced to flow from inside to outside diameter of the impeller because of rotative speed of the impeller.

Likewise the kinetic energy is given up by the fluid in the runner section as it flows from outside diameter to inside diameter of the runner. The result of the circulatory velocity between the vanes of the impeller and runner plus the rotative velocity of the two elements causes the path of fluid to be a spiral. The action of the fluid can best be simulated by tracing the path of the wire of a helical spring whose ends are brought together to form a circle. The hydraulic coupling depends on the weight of fluid and its velocity impingement on the runner vanes for power transmission and not on shear action of the fluid. In actual fact the drive is analogous to a centrifugal pump discharging fluid into a reaction turbine. In order to establish a circulation between the runner and impeller there must always be a difference in speed between the two elements. The percentage difference is termed "slip."

Since the kinetic energy is the principle upon which the operation of the hydraulic coupling depends, it would be expected to follow $KE = \frac{1}{2} MV^2$ which is the case. The output torque must equal the input torque. No derivation is offered here, however, it can be stated that:

1. At constant diameter and constant slip the torque transmitting capacity of a hydraulic coupling varies as a square of the speed ($V^2$).
2. At constant diameter and constant slip the power transmitting capacity varies as $N^3$.
3. At constant slip and constant speed the power transmitting capacity varies at the fifth power of the diameter ($D^5$).

From the above it is possible to write an equation:

$$Hp = N^3 \times D^5 \times K$$

Where K is a constant which takes into account design, internal friction, fluid used, and slip. This factor can only be determined experimentally. Over a limited range of operation the value of K varies directly as the slip.

There are three basic arrangements of fluid couplings with which our company has been concerned.

## MARINE FLUID DRIVE

Figure 3 shows a typical cross section of a marine coupling assembly in a reduction gear box. The stationary gear case is built to include the rotating members of the hydraulic coupling. The primary rotor or impeller is supported on a stub shaft which, in turn, is connected to an extension of the diesel engine shaft. For the reason of compactness of design, there are times when the impeller is mounted directly to an extension of the engine shaft, thereby eliminating the stub shaft shown. The secondary rotor or runner is connected to an extension of the pinion shaft of the gear box. In this arrangement, fluid for the hydraulic coupling is pumped from a sump of the gear box through a regulating valve into the hollow shaft of the pinion gear and then into the working circuit.

The use of two marine engines in parallel driving through hydraulic couplings to pinions both of which mesh with a single bull gear connected to the ship propeller shaft has found wide favor. Each engine takes its share of the load. The couplings provide a convenient means of clutching and declutching either or both engines as well as positively prevent transmission of torsional vibrations. The marine coupling has also been used extensively for transmitting power from the diesel engine directly to the propeller shaft. In this case, the reduction gear is not used and the propellers turn at the same speed as the engine, minus the slip of the coupling.

It should be noted that in the marine coupling arrangement, the rotating housing which confines the fluid in the working circuit is bolted to the runner instead of the impeller. The purpose of this arrangement is to reduce the weight and particularly $WR^2$, thereby raising the engine crankshaft critical speed. There are certain variations added to the marine coupling, such as quick dumping valves for rapid declutching of either or both the engines from the propeller, a quick-filling feature required for rapid clutching of the engines, and regulating valves which make possible partial filling of the unit in order to provide increased slip across the coupling and slower propeller speed. The size and weight of the marine coupling is determined by the speed and the delivered horsepower of the engine. The usual selection of hydraulic coupling is made on the basis of an efficiency of 97 to 97½ per cent.

### TRACTION TYPE FLUID DRIVE

Figure 4 shows a typical cross section of a traction type of fluid drive. It is a self-contained unit and is usually mounted directly onto the engine flywheel in the case of an internal combustion engine or onto the output shaft of electric motors. The traction type fluid drive consists of the impeller member connected to the engine or motor, a driven member or runner, a baffle, the casing, the pilot bearing, a driven shaft connection, an oil seal, and a mounting flange. The coupling operates with a predetermined quantity of oil sealed into the unit.

The most common usage for this type of unit occurs in our present day passenger automobile. The type of unit which we are discussing is closely duplicated today in the fluid drive used by Chrysler. The use of this type of unit in industrial drive varies widely in kind of application and size of unit. Before considering the industrial application of this unit, it would be well to examine the capacity of the unit at varying speed and slip. Figure 5 shows a typical set of performance curves for a traction coupling. This set of curves is based on the previous theorem that at constant diameter and constant slip the torque transmitting capacity of the hydraulic coupling varies as a square of the rotating speed. The position of various square curves depends entirely on the design of the hydraulic coupling. The capacity data is entirely experimental. It would be extremely difficult to determine the capacity information by mathematical calculation. From the intersection of

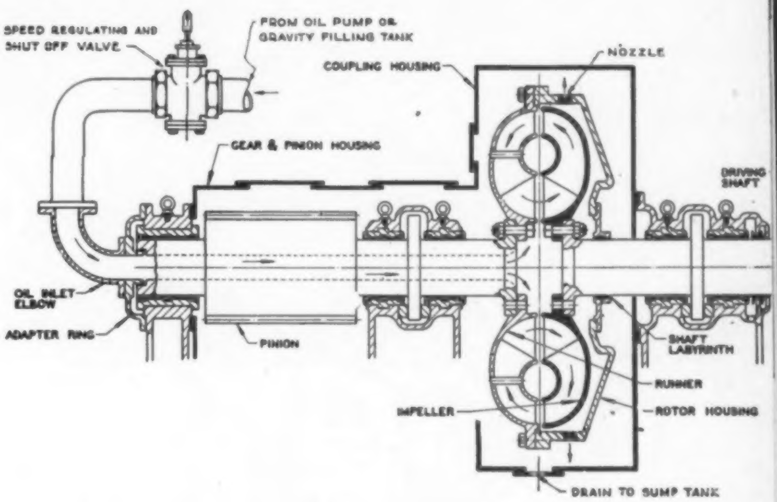


Figure 3 — Diagrammatic arrangement of a marine hydraulic coupling equipped with constant leak nozzles.

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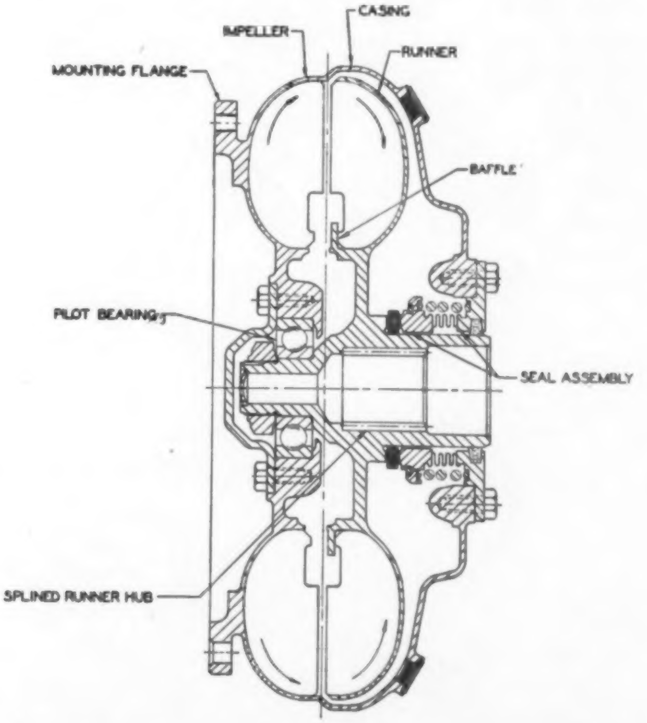
Figure 4 — Cross section of the traction type fluid drive.



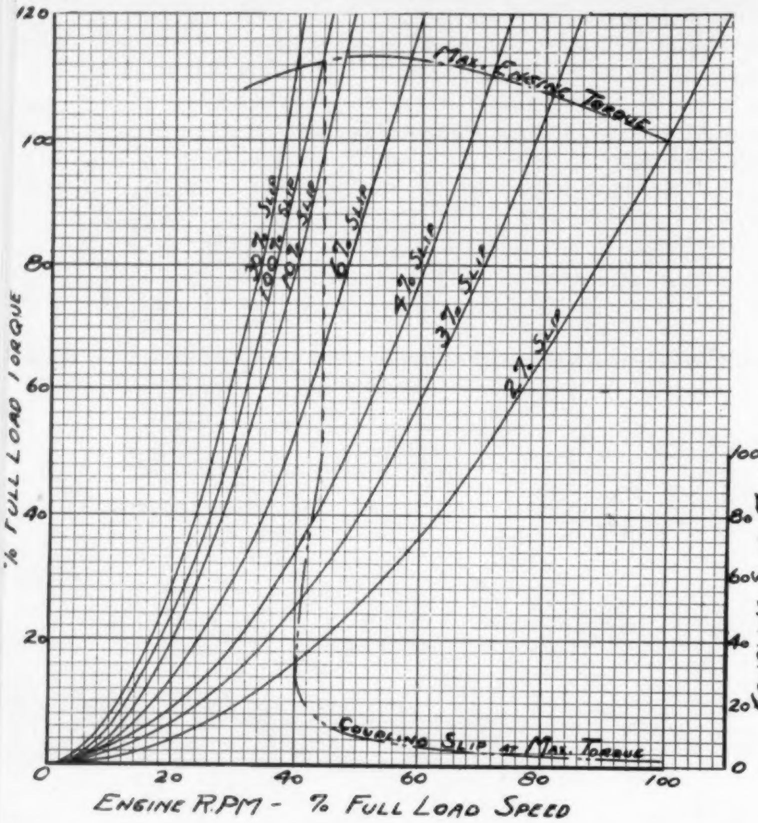


**Figure 5 — Curves showing torque transmitting capacity of the traction type fluid drive.**

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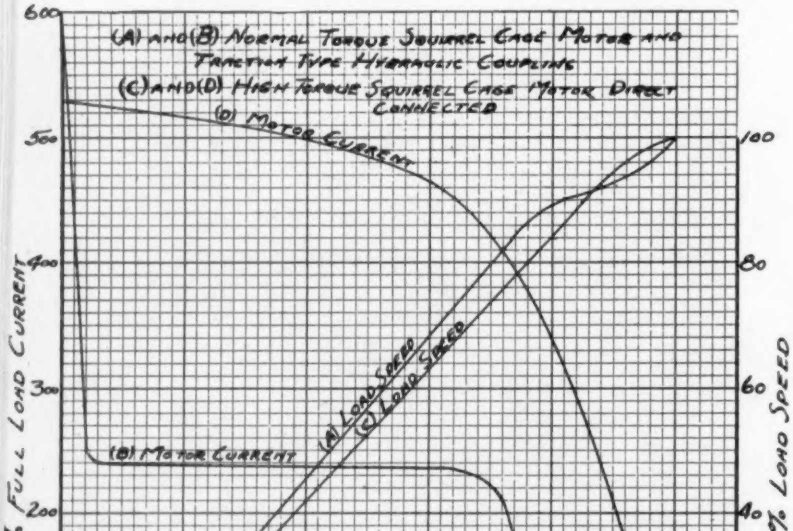
**Figure 6 — Performance curves of a high torque direct connected squirrel cage motor, and a normal torque motor with hydraulic coupling starting high inertia load.**



the engine curve and the capacity curves a coupling slip curve has been developed which shows the capacity of the fluid unit at various engine speeds to transmit the torque developed by the engine at full throttle. It is possible by likewise superimposing any other torque data on these curves to determine how the fluid unit will function under the torque and speed condition which may be under consideration. In making application of the traction type fluid drive to engines, it is always desirable to make a selection of unit in order that as much of the usable engine horsepower is transmitted across the hydraulic coupling to the driven machine as possible. The second consideration in making a selection for this engine requires that the stalled speed or the point of 100 per cent slip be realized at an engine speed immediately lower than the speed at which usable power is developed by the engine. This stalled point is always selected for some engine speed above where the engine will stall due to overload. By adjusting the filling and baffle thereby shifting the performance curves, this same fluid drive is applied to electric motors. It should be noted here that the capacity curves all originate at zero torque at zero speed. Interpretation of this characteristic for either electric motors or internal combustion engines means that an engine or an electric motor always starts under no load condition. The speed at which the internal combustion engine or the electric motor will develop its maximum torque through fluid drive occurs at the point at which the curve of 100 per cent slip intersects the torque curve of the power source. Figure 6 shows a comparison of performance of two motors of similar rating and same speed. Curve A shows acceleration of a load driven by a normal torque squirrel cage motor through the traction coupling. Curve B shows the value of current required by the motor during the entire accelerating cycle. Curves C and D show the acceleration and current required by a high torque low current motor to start the same high inertia load direct connected.

## VARIABLE SPEED FLUID DRIVE

The third type of hydraulic coupling is the variable speed unit, two designs of which are shown in Figure 7 and Figure 8. These units are designed with means whereby the quantity of fluid within the hydraulic coupling can be varied with the idea of obtaining varying speeds of the driven shaft with constant speed of the driving motor. Both of these arrangements accomplish the same results. The pump controlled variable speed hydraulic coupling, Figure 7, is designed with a stationary reservoir tank from which is pumped whatever quantity of oil is needed to satisfy driven machine conditions. The pump is of the gear type and is driven by separate electric motor. The pump may be run continuously and the quantity of oil controlled by valves or the pump may be run intermittently and reversed when the oil is to be removed from the working circuit. The scoop control hydraulic coupling shown in Figure 8 is an alternate arrangement for varying the quantity of oil in the working circuit to provide varying speed on the driven shaft. In the case of the scoop controlled hydraulic coupling, the reservoir is made of such a diameter that the quantity of oil required by

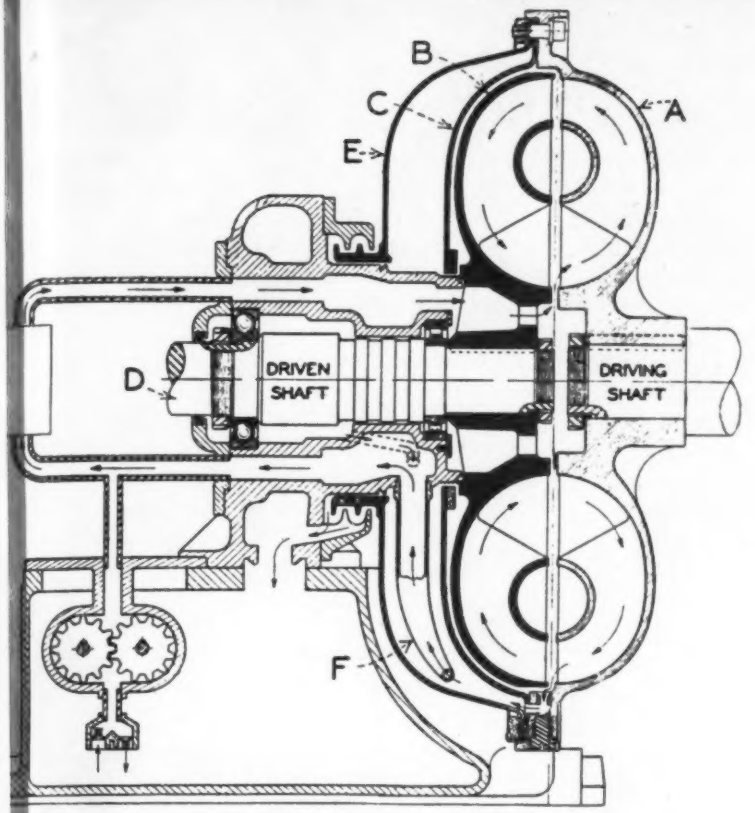


**Figure 7 — Pump controlled variable speed fluid drive.**

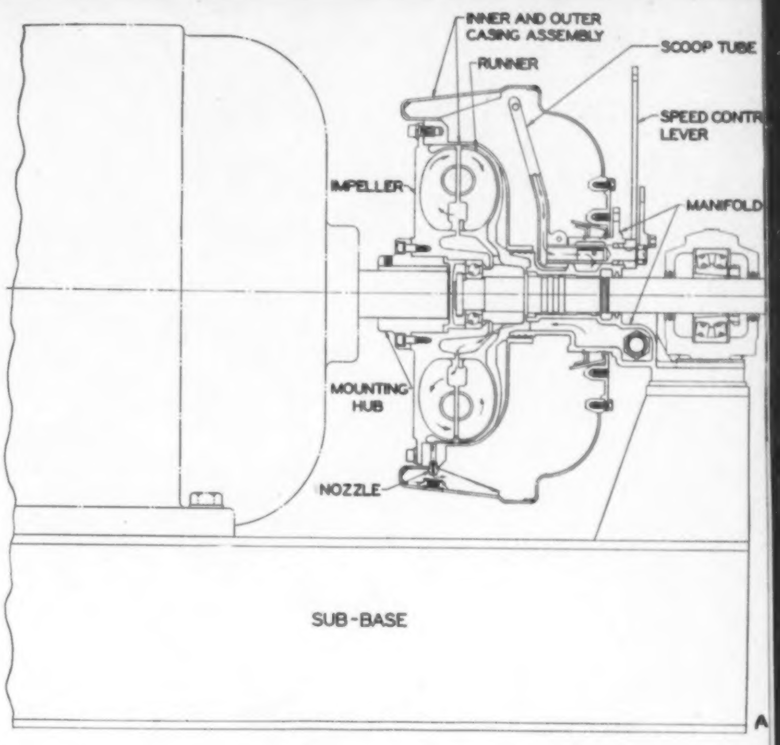
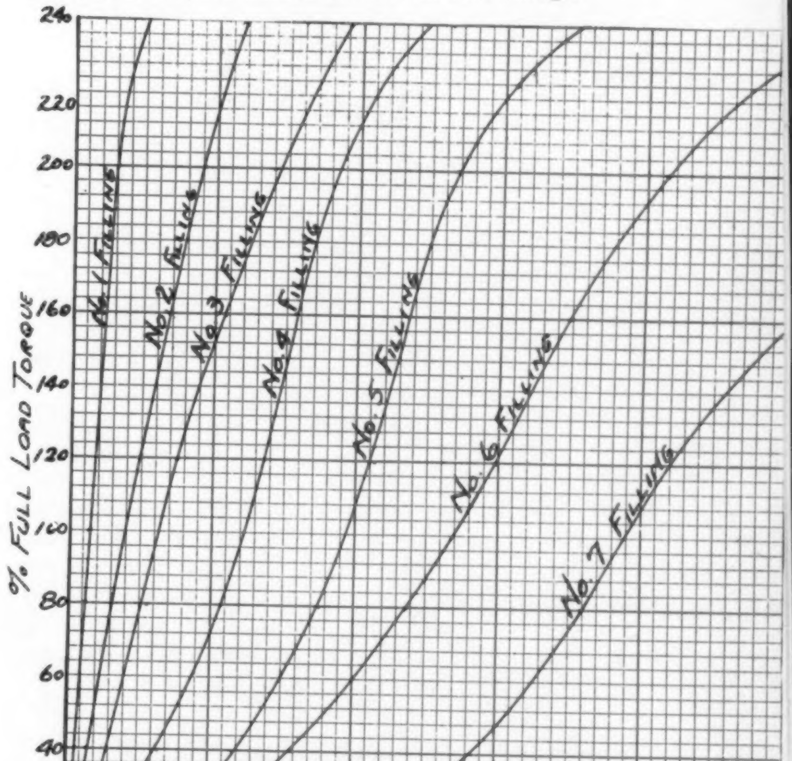


**Figure 8 — Section through a scoop control variable speed fluid drive.**

**Figure 9 — Curve showing torque transmitting capacity of variable speed fluid drive at constant fillings.**



the working circuit for maximum speed and efficiency is contained in a ring of oil rotating outside the working circuit. The scoop tube position is varied in this unit and the quantity of oil required to satisfy the speed conditions of the driven machine picked up from the rotating ring of oil and transferred to the working circuit of the hydraulic coupling.

Figure 9 shows a typical set of performance curves for a variable speed hydraulic coupling. Each curve in the family of curves represents the torque transmitting capacity of the coupling at a certain filling. It will be noted that as the torque loading on the hydraulic coupling increases for a certain quantity of oil, the slip likewise increases. This type of performance curve makes it possible to predict the performance of the variable speed coupling when the torque loading on the driven machine can be superimposed on the capacity curve of the fluid unit and from this curve, the degree of control can be accurately predicted.

It is particularly interesting to examine the applications of fluid drive which have been made in the iron and steel industry. It is also of interest to discuss some of the future possibilities of this method of power transmission in the iron and steel industry. Fluid drive has been applied in practically every phase of your industry from the mining of the raw material to the finished product.

## MINING

The first large scale use of the traction type fluid

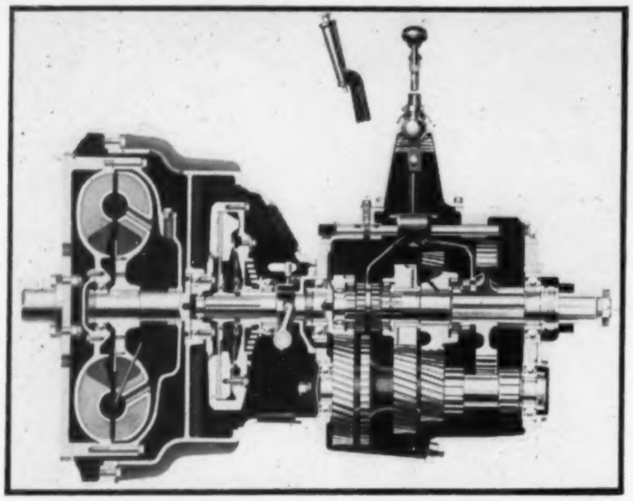


**Figure 10 — Assembly arrangement of traction type fluid drive and mechanical transmission.**

drive in mining occurred in an open pit iron mine operation in Minnesota in 1939. At that time a decision was reached by one of the mining companies to begin a truck operation from open pit mines where locomotive track benches in the mines had caused restricted operation. Certain specifications for such a truck were laid down which included the traction type fluid coupling. The truck was designed to carry net payload of 34,000 pounds on a continuous 8 per cent grade at least 8 miles per hour. The engine developed approximately 205 hp at 1600 rpm. In operation, the speed which was specified was considerably exceeded. Since the initial six units in 1939, 68 additional identical units, except for increased amount of power, have been built. An arrangement of parts similar to that shown in Figure 10 was used. The fluid drive was mounted to the engine flywheel. The output shaft of the unit was fitted with a clutch plate and the clutch was installed between the traction coupling and the transmission. In this case, the friction clutch was used merely as a disconnecting unit for the purpose of shifting the transmission. The fluid unit was used for load pickup. After some experimenting with the engine and fluid drive it was found that best over all performance of loaded operation of these vehicles was obtained by starting and accelerating the truck in the gear ratio in the transmission which corresponded to maximum vehicle speed obtainable at maximum engine speed and horsepower. This vehicle operation was favored by the fact that the engine was capable of developing a comparatively high peak torque at pull-down speed and the fluid coupling permitted the engine to continue to develop this peak regardless of vehicle speed during the accelerating period.

The traction type fluid drive has also been used in diesel mechanical shovels of 2¼ yard capacity in digging iron ore in open pit mining. The first of these applications was made approximately five years ago and the application has been repeated in various makes of machines since that time for the same duty. In connection with shovels, one of the very desirable features of the coupling was its ability to prevent breakage in very heavy digging and at the same time prevent stalling of the engine in case the bucket becomes stalled in the ore body. The writer witnessed the operation of such a machine equipped with fluid coupling digging iron ore next to the rock formation around the ore body where the shovel operator was frequently confronted with projections of rock. In this particular operation, the ore could not be blasted loose because of the nearness of the rock formation and except for the fluid drive, removal of the ore with a mechanical shovel would have been an extremely severe operation on both the operator and upon the machine. Engine and motor driven cable excavators are subjected to the same loadings as shovels. It would be expected that the same results with proper application of fluid drive could be achieved.

The application of fluid drive has been made to still other mining machinery. Machinery for underground operations, such as car pullers, scraper hoists, shaft hoists, diesel-mechanical locomotives, engine powered muck loaders, and trip makers are in successful operation using the traction unit. The results obtained from these applications have been observed over a period up to five years.

The traction type of fluid drive has added several important and desirable features to electric motor driven equipment. Shock loading to which such machin-

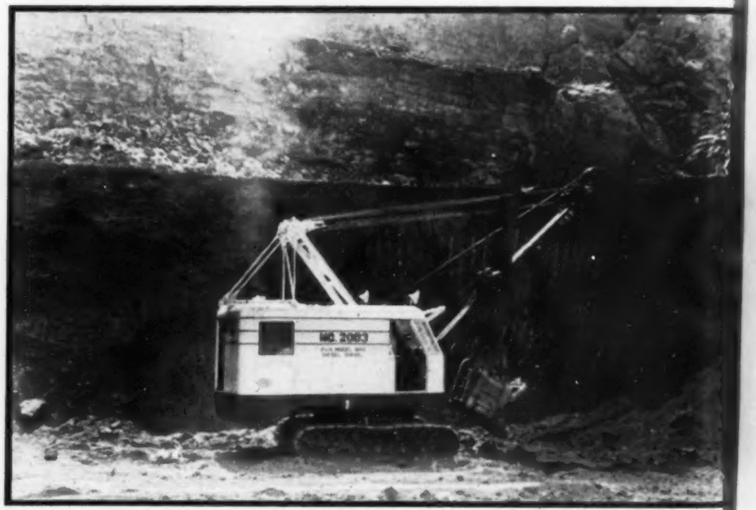


**Figure 11 — 2¼ yard power shovel with fluid drive used in iron ore mining.**

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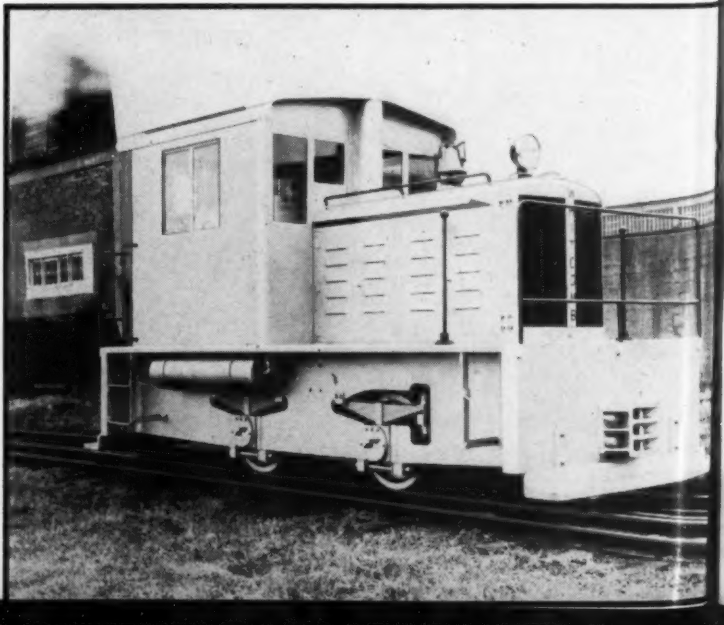
**Figure 12 — Diesel mechanical locomotive with fluid drive.**



ery is subjected has been minimized due to the ability of the fluid coupling to separate the action of the high speed and high $WR^2$ of the motor armature from the drum and cable. In all cases the amount of control equipment has been reduced and simplified because of the no-load starting of the motor made possible by use of the hydraulic coupling. The maintenance required on control equipment is less because of lower current values required to be handled by control contacts.

Diesel-mechanical underground mine locomotives with fluid drive were mentioned above. The locomotives in one large tunnel job were of this type. The arrangement of parts including the fluid drive were similar to Figure 10. In this application, the traction coupling has shown a particular advantage which makes possible the starting of the high inertia rolling load of the train with a minimum amount of gear shifting. Control of the train speed by engine throttle and brakes is an accomplished fact.

Of interest on the tunnel locomotives in addition to the fluid drive application was the elaborate use of spark eliminators and scrubbers for the engine exhaust gases.

Fluid drive performance on such machinery as belt conveyors is very attractive. Of importance is the possible simplification from wound rotor motors and magnetic starter panels to squirrel cage normal torque motors with the traction couplings and direct starting. In addition, load balance between the several motors of a multi-motor belt conveyor drive can be accomplished with squirrel cage motor and traction couplings. This ability is a proven fact in a number of long industrial conveyors where two or more motors were necessary in the drive.

Of possible interest to the user of the underground electric mine locomotive and d-c current is the thought that fluid drive with d-c motors could simplify the control equipment, to a field rheostat to provide a 3 to 1 speed range of the motor. Preliminary studies indicate that such an arrangement is not impractical.

In processing of ore, the variable speed hydraulic coupling has been used for volume control of both centrifugal pump and air supply fans. One of the very attractive installations which has been made was in connection with sintering fans.

## TRANSPORTATION

Transportation of ore from the mine to the smelter requires power, space, and time as well as labor. Although diesel ships for such service at this time are not in the majority, it may be found that economy will dictate consideration of this form of power. To further the desire for economy, relief from maintenance is necessary. The marine coupling has proven itself in this field of power transmission.

## FUEL

The fluid drive is transmitting power the industries which supply fuel for the iron and steel industry. The first of a series of heavy off the highway trucks designed to carry a net payload of 80,000 pounds of coal was put into service in 1939 replacing a twin engine diesel-electric drive on which approximately one-third more power had been provided. The fluid drive equipped truck was powered with a 225 hp, 1600 rpm engine. The transmission provided eight speeds forward and two speed reverse. The performance of this unit duplicated the diesel-electric unit. Recently an application of a fluid drive to a 325 hp, 2000 rpm engine was made for a vehicle carrying a net payload of 65 tons. The gross loaded vehicle weight was in excess of 210,000 pounds. The performance of the vehicle is outstanding.

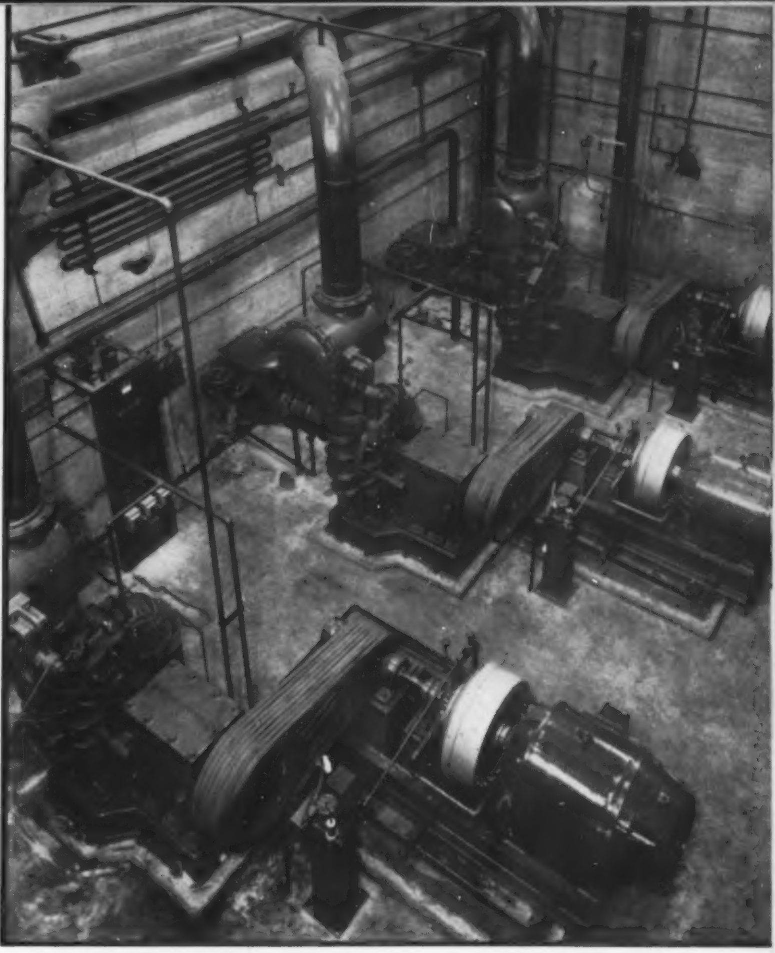


**Figure 13 — Ore recovery pump driven by scoop control fluid drive and constant speed motors.**

In the fuel industry, fluid drive has proven effective in trip makers where a harmless momentary stall of the machinery is required at times. As in the case of the car puller, the traction coupling makes possible the use of simple starting equipment for constant speed motors to accelerate the high inertia load of a train.

## POWER PLANT

Fluid drive is used in the steam generating stations of the iron and steel industry. Variable speed for forced and induced draft fans has been considered an item of economy in power plant operation. Economy of operation is not only considered from the standpoint of power saving but also relief from maintenance and accuracy of regulation of the power plant auxiliaries. Variable speed hydraulic couplings for boiler feed pump where accuracy and precision of speed regulation are paramount are an established application.

The forced and induced draft fans for the power station of one of the new large steel mills built since the beginning of the war are equipped with variable speed hydraulic coupling operating on automatic control.

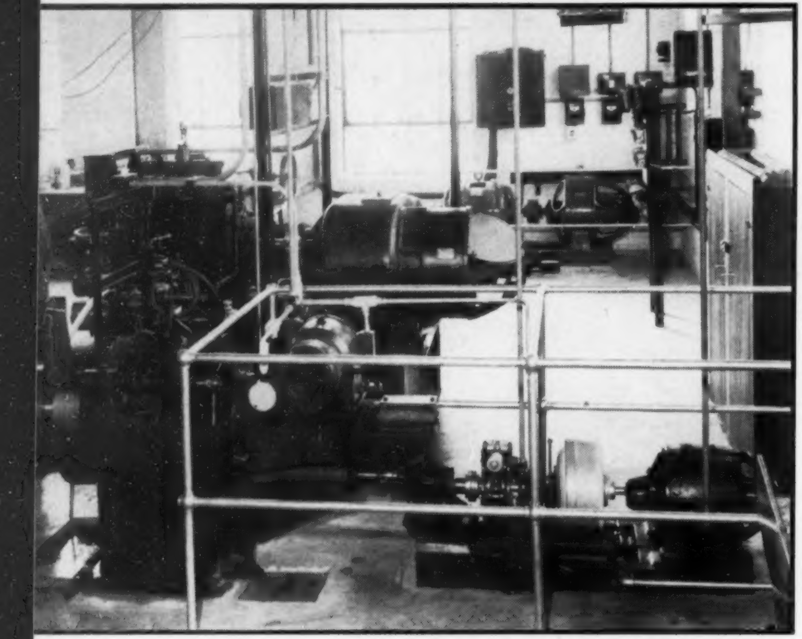


**Figure 14 — Winder drive equipped with scoop control fluid drive coiling bi-metallic strip.**

Fluid drive is transmitting a total of 7300 fan hp in this one power plant.

## STEEL MILL AND FOUNDRY

Fluid drive is being used in the foundry and steel mill. Variable speed for pressure and volume control of gas boosters and pumps is being accomplished by constant speed motor and variable speed hydraulic couplings and generally, automatic control. Also variable speed hydraulic couplings are being used to control capacity of centrifugal refrigeration machines for blast furnace air dehumidification.

The traction type of fluid drive and electric motors are being used for such drives as furnace doors, furnace charging equipment, ingot strippers and mandrel extractors. This type of fluid coupling permits pickup of the motor load with a minimum of control equipment without shock and limits torque without stalling of the electric motor rotor with consequent high current values. Recently traction couplings and direct starting constant speed electric motors have been used for starting the high inertia fan wheel of forge blowers. The wound rotor motor was previously considered necessary. The traction type of fluid drive is a valuable addition to the skip hoist.

Application of fluid drive to diesel mechanical yard locomotives and to travel motors of yard cranes have been made to gain controlled pickup of high inertia rolling loads. Approximately 60 locomotives varying in size up to 35 tons are in service, the first of which was built 4 years ago.

Of particular interest to the foundry is the application of traction fluid drive to the start and stop high inertia mould conveyors. This application has been valuable particularly in the nonferrous foundry in obtaining an ingot with smoother surface at a higher mould level. In one of these applications, the pouring capacity is 80 tons per hour. The conveyor stops and starts once every eight seconds. In this case a special high torque motor was used in order to reduce the time normally required by a motor to accelerate its rotor.

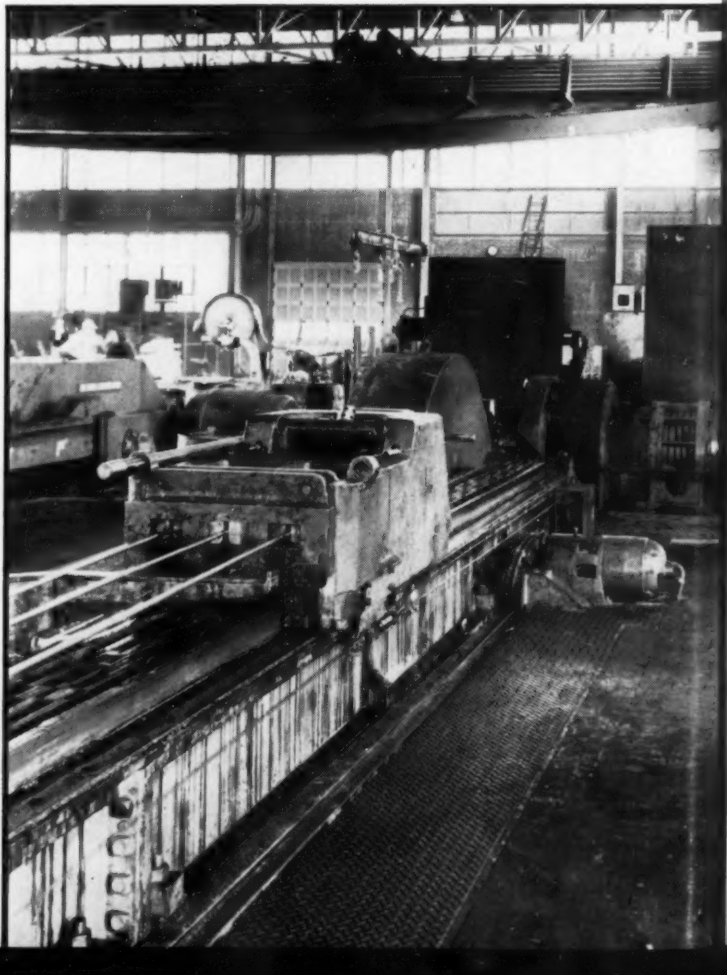
## PROCESSING

Processing of steel to the final finished product requires a large amount of power. In many of the finished products the quality of the product is dependent on the proper application of that power to those machines.

Both variable speed and traction type fluid drive have been used successfully in strip winding and wire coiling. As is the case with other apparatus used for winding, the application of fluid drive also requires careful consideration. Among such reasons for giving consideration to fluid drive for windings are close control of speed and tension and low maintenance. Reduced first cost over other equipment to do a comparable job has also been realized. Fluid drive is being used on wire drawing, stranding, bunching, and braiding machinery. The type of fluid unit which has been used depends on the speed requirement. In every case smooth, rapid acceleration and control has been the reason for its inclusion.

The draw bench requires for its successful operation, the application of power in the stepless, even flow manner which is an inherent characteristic of fluid drive. Both variable speed and the traction type of fluid drive have been applied to draw benches using constant speed a-c motors. On the type of bench where

**Figure 15 — Draw bench drive driven by 250 hp, 900 rpm motor through scoop control fluid drive.**



one speed of draw is required the traction coupling is being used. On those benches where changing speed for different stock is required, the scoop controlled coupling has been used. The entry of fluid drive into this field has been comparatively recent, however, the results on benches up to 100,000 pounds have been good. The applications are being repeated.

Fluid drive has produced results worthy of note on tire rim forming machines. Due to section variation of the metal to be rolled, direct mechanical connection between the bull roll and outer form rolls on rim forming machines produced scarfing and subsequent metal finishing operations on a portion of the rim production. Recognizing that scarfing was actually a condition of unbalanced power between the rolls it was decided to drive one set of rolls through a hydraulic coupling which would automatically change relative speed slightly between the two sets of rolls when the metal section changed. These machines have been in operation approximately six years.

The traction type of fluid drive has recently been applied to tube reducing machines to reduce the effect of shock loading and reversals of stress caused by the reciprocating head of the machine. Although the application is comparatively recent, results so far indicate that fluid drive is performing with very satisfactory results.

Of interest to the processing industry is a drive worked out in manufacturing bomb shells. The indexing drive of a bomb nose forging machine has been successfully worked out using a constant speed motor and traction type of fluid drive. The unit was used to maintain a turning effort at all times on the tubing being forged. At each stroke of the forging hammer, the output shaft of the coupling was stalled. At the moment of release, the turning effort produced an instantaneous indexing of the material preparatory to the next hammer blow. The electric motor driving the coupling impeller continued to run without overheating and subsequent damage to the motor.

In the iron and steel industry, electric power particularly in processing, is predominating. It would be of interest, however, to describe a diesel power application to a rod mill in the non-ferrous field where fluid drive played an important part. The mill, which has been in successful operation approximately five years, is producing ⅜ in. wire from copper billets. It consists of three rough passes on the primary stage and six passes on the secondary stage. The primary stage is driven by a 450 hp diesel engine through a traction type hydraulic coupling and 10 to 1 ratio gear box, the output shaft of which is connected to the shaft of the primary stage. A flywheel weighing approximately 20 tons is mounted on the shaft of the primary stage to which the gear box output shaft is connected. The peak energy for the mill is taken from stored energy in the flywheel by the engine on the off-peak period and is taken from the flywheel at the expense of speed drop of the flywheel. The fluid drive is first isolating the engine from the extremely high inertia system which is being driven thereby eliminating torsionals. Secondly the unit provides the "rubber band" in the system that allows the speed fluctuation of the flywheel with a minimum of fluctuation of engine speed. The engine tends to remain loaded on the off-peak cycle of the mill. Although the traction coupling was never intended to be a protection against damage in case of sudden stall of the mill, such stalls have occurred and it is generally agreed that the coupling did protect the engine.

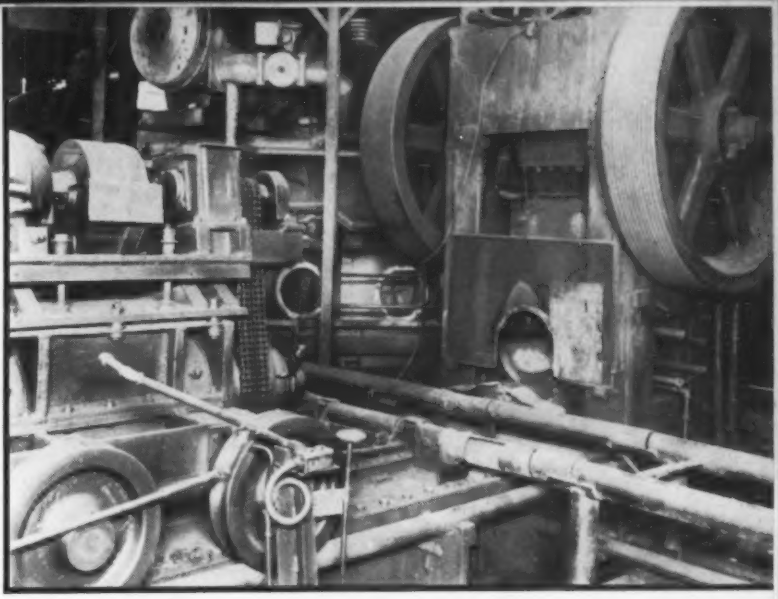


**Figure 16 — Bomb forging machine with indexing drive equipped with traction type fluid drive.**

### CONCLUSION

Many of the applications which have been discussed have been made during the war with limited manpower and limited capacity for producing industrial drives.

Well over 1200 marine couplings have been produced by my company to transmit diesel power aboard AM, AVP, DE, PC, LSM and YT vessels. Approximately 2,300,000 connected horsepower is represented.

The variable speed coupling has played an important part in power recovery during the war. In large aircraft engine production, it was realized that a tremendous loss of power was resulting in the conventional propeller method for loading engines for test purposes. Through the combined efforts of many companies, a power recovery engine test stand was developed. The equipment consisted of a synchronous generator connected into power lines, a variable speed coupling which could be adjusted to compensate for the difference between the speed of the engine test speed and the synchronous speed of the generator; and a suitable connection between the coupling input shaft and the engine propeller shaft. This equipment was capable of recovering approximately half the total energy developed by engines on production test. In one aircraft plant approximately 130,000 connected generator horsepower has been installed.

A large number of small variable speed high speed units have been built for aircraft engine. Over 1,000,000 hp is being transmitted by these small units. These units are automatically controlled to compensate for a changing barometric pressure at varying altitudes so that the power output of the engine remains constant. In order to build the strength and close detail of construction into this small unit a process of hydrogen brazing was developed. The technique which has been developed in producing this unit is considered to be outstanding in the hydrogen brazing process field.

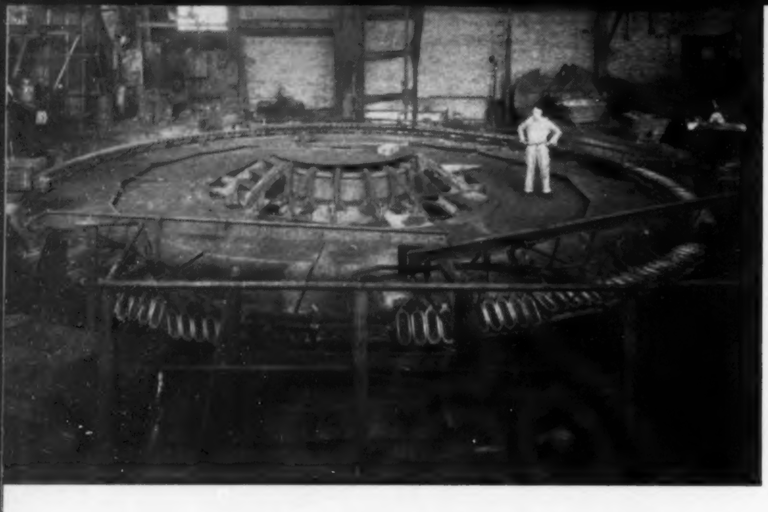


Figure 17 — Mold conveyor equipped with fluid drive.

The new and better methods and processes that have been developed are being put to use as rapidly as possible. Where cast iron was originally used, all rotors for all sizes and classes of fluid drive units are now fabricated from die formed parts and welded steel construction. The results are higher efficiency, better performance, lighter weight and particularly lower $WR^2$. The store of knowledge of capacity and control of fluid drive has increased tremendously. Research facilities have been expanded and are being used to increased advantage.

It seems reasonable to believe that the industrial drives which have been discussed have not reached the ultimate. Better understanding of the requirements of drives in the iron and steel industry coupled with improvements that are continually being made through research in fluid drive will further simplify these drives with resulting economy in first cost and operation.

# DISCUSSION

PRESENTED BY

**A. J. WARDLE, JR., Sales Department, The McKay Machine Company, Youngstown, Ohio**

**W. H. COLLISON, Superintendent Coke Plant, Blast Furnace Division, Great Lakes Steel Corporation, Ecorse, Detroit, Michigan**

**G. V. EDMONSON, Staff Engineer, Hydraulic Coupling Division, American Blower Corporation, Detroit, Michigan**

**C. E. HAGUE, Field Representative, Askania Regulator Company, Cleveland, Ohio**

**L. F. McCAFFREY, Engineer, Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin**

**O. J. LEONE, Regional Manager Steel Mill Division, The Bristol Company, Pittsburgh, Pennsylvania**

**A. J. Wardle:** My comments have to deal entirely with the use of fluid coupling on draw bench drives. For cold drawing of metal stock, a relatively fast drawing speed is desirable to attain maximum production but if the draft is initiated at fast speed, frequent trouble is encountered with breaking or pulling the ends from the stock with ensuing loss of production, and the attendant shock on the tools and drawing machine resulting in high maintenance cost. Usually these troubles are somewhat diminished by utilizing a multi-speed driving unit which provides a relatively slow or base speed for initiating the draft with subsequent acceleration to the fast drawing speed.

The several types of these multi-speed driving units increase the first cost of an installation and the extent of this increased cost considered with their respective merit and deficiencies might be expected to show a trend toward a preferred type, but such a trend is not clearly discernible. Generally, these multi-speed drives have been deficient in their relatively non-resilient application of the mechanical energy.

For some years, we have hopefully scanned the field for motor and control, for the most economic first and subsequent operational and maintenance cost for application to the drawbench; to convert the usual a-c electric energy as commonly supplied by the power company to two or more selected drawing speeds in automatic sequence. Recent applications to this end have been by constant speed motor through the transmission medium of the variable speed hydraulic coupling, however, the conventional drawbench operation involves frequent and successive cycles of change from light load to drawing load and vice versa. Mr. Edmonson's paper showed that the coupling fluid medium transmits kinetic energy and further, the rotor is of comparatively low $WR^2$, so there is but a negligible potential energy available to substantially maintain fractional speed during the relatively sudden imposition of the drawing load. Obviously, some time element is necessary to increase the quantity of fluid in the coupling working circuit and if fractional speed is being maintained under light load, then imposition of the drawing load will result in loss of output speed until sufficient time has elapsed to adequately increase the quantity of working fluid. This loss of speed is objectionable only as it tends to diminish production and is an inherent characteristic of the variable speed hydraulic coupling, but is obviated by auxiliary means which prevents undue loss of speed.

On the other hand, the hydraulic coupling simplicity, its inherent property of shocklessly assuming the suddenly applied load, and smoothly acceleration to and maintenance of selected approximate drawing speed from a constant speed driving source is outstanding.

Experience has shown that the hydraulic coupling transmission enables the draft to be initiated at faster speed, which favors production, without the usual shock and strain on the drawbench mechanism which favors low maintenance.

For reasons of relatively lower first cost and subsequent maintenance, plus very acceptable performance, the sprocket and chain type drawbench is in so extensive use that it may be considered as standard in the industry. However, the sprocket introduces a fluctuating drawing velocity because its chordal pitch differs from its circular pitch. Here, the hydraulic coupling has a very favorable effect in diminishing the magnitude of the velocity fluctuations and this is particularly true of the variable speed coupling, as the speed dial may be readily adjusted so the coupling working circuit will be filled with fluid only to the extent demanded by the drawing load. This ancillary benefit to the chain type drawbench will further bear favorable comparison with other more costly types of benches.

Adjusting the fluid content of the coupling working circuit to that demanded by the drawing load has its counterpart in diminishing the peak electric inrush current to the motor, which may be of the synchronous type when power-factor improvement is desirable, thus diminishing cost of electric power. The draw motor control may be standard for occasional starting duty, while the automatic speed control is delegated to secondary control appliances.

Briefly, the variable speed hydraulic coupling applied to the drawbench with a constant speed power source, is a speed variator of reasonable cost which may be controlled to favor economy in electric power cost, attain good production, and to diminish shock and strain to the drawbench structure, and thereby favoring low maintenance cost.

**W. H. Collison:** I notice, in some cases gear reductions were used in conjunction with hydraulic couplings. What considerations are there in deciding what that arrangement might be?

**G. V. Edmonson:** The fluid coupling is a machine which will transmit torque at a one to one ratio. In other words there is no torque multiplication. The gear box is a torque converter in which torque at higher speed (or a certain amount of power) is put into the gear box on the pinion shaft and higher torque at lower speed in direct proportions to the ratio (same amount of power less gear box efficiency) is realized on the output shaft of the gear box. The fluid coupling transmits torque directly from the motor at one to one ratio and provides a variable speed at the input shaft of the gear box.

**W. H. Collison:** What are the maximum limitations on horsepower of units currently being built?

**G. V. Edmonson:** The maximum limitations are, of course, physical limitations brought about by the limit of strength of materials. Rotative or tip speeds must be held within these limits. With present mechanical construction we are building one unit at 4000 hp right now. On constant torque duty, there is a limitation on maximum heat load which limits the maximum reduction in speed we can recommend. Efficiency of a fluid coupling is 100 minus the percent slip. If the slip is 50 per cent, the efficiency is 50 per cent. The input horsepower to a fluid coupling is equal to:

$$\text{Input hp} = \frac{\text{Hp required by the driven machine at some speed}}{\text{Efficiency of fluid coupling at same speed}}$$

and the horsepower loss in a fluid coupling is:

$$\text{Hp loss} = \text{Input hp} - \text{Output hp}$$

The horsepower requirement of a driven machine which requires constant torque (or constant turning effort) varies directly as the speed reduction from top speed; therefore the horsepower input to the fluid coupling remains constant. On a fan or pump type of load, the horsepower input varies as a cube of the speed reduction; therefore the power input to the fluid coupling likewise varies and becomes progressively less. Variable speed is the most efficient method of providing variable volume control of a fan or centrifugal pump.

**C. E. Hague:** I would like to ask what limitations you would have upon the scoop tube type of couplings; that is, the time limit for variation of the oil content of the coupling to go from full load to a minimum load condition for the purpose of regulation?

**G. V. Edmonson:** For the variable speed type of unit our limitation in decreasing speed is the nozzle. It is a calibrated nozzle regulating the rate of oil flow. Based on units operating on automatic control particularly on fan drive or similar type of drive, a total time for decreasing speed of about one minute has been found satisfactory. In the scoop controlled type of unit we can remove the oil in a minimum of ten seconds. Oil pumping capacity regulates the speed increase time.

**C. E. Hague:** Is this pump size?

**G. V. Edmonson:** Yes, in the pump controlled variable speed unit. In the scoop controlled unit, the pumping capacity of the scoop tube is very, very high. It will pump oil into the circuit at a very fast rate. By merely jerking it into the rim oil by the outside lever the pumping capacity is high immediately. In the pump controlled unit, the pump is generally a motor driven gear pump and there is generally an economical limit to the size of this unit.

**C. E. Hague:** Which is more expensive?

**G. V. Edmonson:** The scoop controlled unit is less expensive. The lower cost unit, however, is for lighter duty due to physical limitations. The large casing required for the rotating reservoir outside the working circuit cannot be driven as high in rpm as the pump controlled unit which is smaller in diameter for the same size of fluid circuit.

**L. F. McCaffrey:** At Algoma a few years ago, we wished we had a fluid coupling, since we had a motor driving a gas booster, and much trouble getting that motor started. We had to start the motor across the line and had trouble getting it up to speed through a speed increaser, and the motor kicked out before getting up to speed. If we had a fluid drive, we would have accomplished that result easily.

**G. V. Edmonson:** We have as a demonstration a three horsepower electric motor on a flywheel of such size that the motor requires three minutes to accelerate the flywheel to speed. After the flywheel is up to speed, it can be reversed. The motor will be momentarily rotated in the same direction as the flywheel because of flywheel $WR^2$. The motor effort, however, is in reverse direction so that it will stop and start rotation in the opposite direction against the rotation of the flywheel.

There are several centrifugal extractor units at the Chicago plant of Wilson and Company on which fluid couplings have been installed. They are on 7½ hp, 1200 rpm motors driving 40 in. baskets. About one minute is required for acceleration and the total cycle is repeated fifteen times an hour. From the time the first unit was installed approximately six years ago, there has not been a motor failure, although we have had one seal failure.

*(Please turn to page 101)*

# AN EXAMINATION OF
# *Slow Cooling Methods*

*. . . . cooling pits are an increasingly important factor in steel quality control . . . . the cooling pit is actually often an annealing furnace, and should be designed and built as such . . . .*

by J. W. Barker and E. R. Cole, ENGINEER
STAFF CONSULTANT INDUSTRIAL FURNACE DIVISION
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PITTSBURGH, PENNSYLVANIA

▲ IT IS not the intention of this paper to discuss the metallurgical aspect of slow cooling, but to present a resume of slow cooling methods as practiced in the steel industry today. The basic reason for slow cooling is to prevent "flake," which can be defined as very tiny fissures occurring in the body of the steel. There are many theories as to the cause of these fissures and there are two methods of dealing with them, one is to slow cool to below approximately 300 F and the other is a cycle annealing.

By either method, in addition to preventing flake, improved results are obtained in machining and shearing qualities. There is no doubt as to the practical value of slow cooling, but there is much discussion on the efficiency of methods employed. However, all methods we have investigated achieved the desired results.

In our investigations on this subject, we found that the early slow cooling processes made use of ashes, gravel, sand, slag, etc. and that the stock was buried in such material. This was not very satisfactory or dependable due to the stock being unevenly covered or to the ends often protruding, thus allowing a great difference in the rate of cooling at various parts of the stock. In addition, this method was slow and expensive, as it tied up cranes and required excessive labor in handling. The industry quickly recognized the necessity of improving this process and, as a result, installed various forms of cooling pits.

The first pits were steel slab lined holes or boxes, and at one western Pennsylvania steel plant many examples of these are being used, each being approximately 15 ft × 9 ft × 8 ft deep, lined with 3 in. steel slabs, backed by slag and gravel, and with 3 in. plates being used as covers.

At this plant, there are about 80 such boxes serving the blooming mill, and they are usually charged with 60-80 tons of blooms and billets each. All grades of 4 × 4 in. billets are slowly cooled for about 5 days. Possibly there should be a variation in this cooling time, depending upon the analysis of the steel, but this is neglected, due to the relatively small difference in the length of time involved and the resulting confusion which would ensue among the operators. The larger blooms, up to 14 × 14 in., are cooled for a minimum of 9 days, an average of 11 days, and in extreme cases, 21 days cooling are necessary in order to be positive that no flake exists. The minimum time for large blooms mentioned above applies to steel similar to SAE-4130 chrome-molybdenum. The 11 days cooling time is common for steels similar to SAE-4340 molybdenum, containing nickel and chromium.

The next step was the installation of brick lined pits with removable covers and one of the first installations of this type that came to our attention was at a Pittsburgh plant manufacturing mine cars, etc. This pit has

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Presented before A. I. S. E. Cleveland Session of Annual Meeting, October 3, 1945.

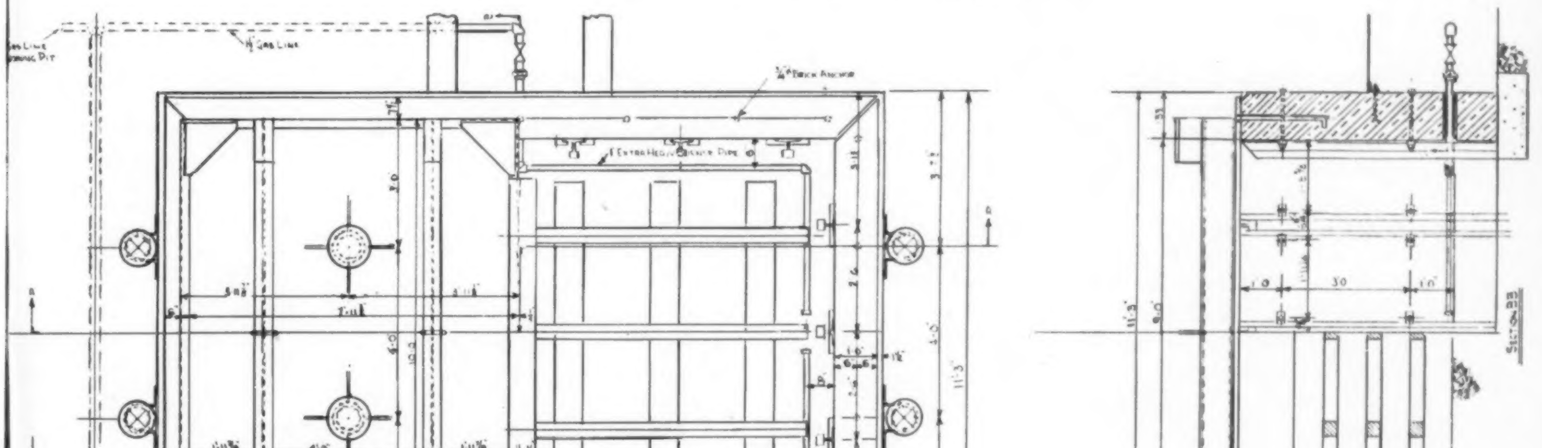
been in service since early 1900, cooling cast wheels for mine cars. It is 10 ft inside diameter × 10 ft deep, is entirely underground, and is lined with 9 in. of firebrick and has an earth bottom. It is similar in shape to a well or an ink bottle, with the opening at the top being smaller in diameter than the 10 ft mentioned. Steel wearing plates are installed around the inside brickwork and there is a cast iron curb and wearing ring, which extends into the neck of the pit. A piece of ¼ in. thick plate formed into a shallow cone, is used for a cover.

The material charged into this pit are wheels of 92 points carbon, weighing from 90 to 200 lb each and the load is from 200 to 250 wheels, making a total charge of from 18 to 20 tons. After the pit is charged, the cover is placed on top and left for a period of 12 hours. After this period, the cover is removed for 24 hours, which permits the charge to cool rapidly to approximately 100 F. Occasionally the temperatures are checked with an optical pyrometer and excellent uniformity is claimed.

In the case of forged steel wheels at one eastern plant, we found that the cooling pits were built solely to eliminate structural stresses which developed in the wheels during air cooling, especially at the thin areas between the hub and tread. In this particular instance, the steel is 60 to 70 points carbon, and 60 to 85 points manganese. The wheels come off the hammer and rolling mill and are stored in racks until they reach a temperature of approximately 1100 to 1200 F, at which time they are charged into the cooling pits. The reason for storing the wheels in racks until they have reached this temperature is to allow a certain hardness of the material to occur, thus preventing distortion from handling and loading into the pits. The pits are built in banks of four each, each section being 6 ft wide, 18 ft long and 5 ft deep and are constructed of first quality firebrick. The wheels remain in the pits from 24 to 36 hours or until a temperature of 300 F is reached, the temperature being checked from time to time with a tempil stick.

At this same plant, material from the billet mill con-

**Figure 1 — General arrangement of axle cooling pit.**


1½" Gas Line
¾" Brick Anchor
1" Extra Heavy Brace Pipe
2" Gas Line
3'0" Between Pits
4" Gas Supply Line
17'0"
11'3"
Section B-B
3'0" Between Pits
Lifting Link
3" Granulated Slag Insulation By Purchaser
Seal Plate
6" Dia. Pipe Vents with Adjustable Covers
Air Inlet 6" Dia. Pipe
4"x4" Billets (Scrap) (By Purchaser)
Scrap Rails (By Purchaser)
Floor Line
8"x8" Low Carbon Blooms (Scrap) (By Purchaser)
14'9"
Section A-A

sists of silicon manganese steel, in the leaf spring steel 86, 94, 93 series. The billets must be placed into the pits at a temperature of 1600 F, but not any higher, as otherwise distortion occurs. The steel is cooled to 300 F in four to five days. There are four pits serving this billet mill, and each holds 100 tons of material. In this instance, the steel is checked periodically by thermocouples to determine the rate of cooling, but no means are available to change the rate of cooling and it is only checked for record purposes.

From the bar mill, two types of products are taken, which are slow cooled, the first being steel coils of 70 points carbon, 85 points manganese and 90 points molybdenum. If these coils were allowed to cool in the air, they would harden to a Brinnell of approximately 600. By slow cooling in pits, the Brinnel is reduced to about 400.

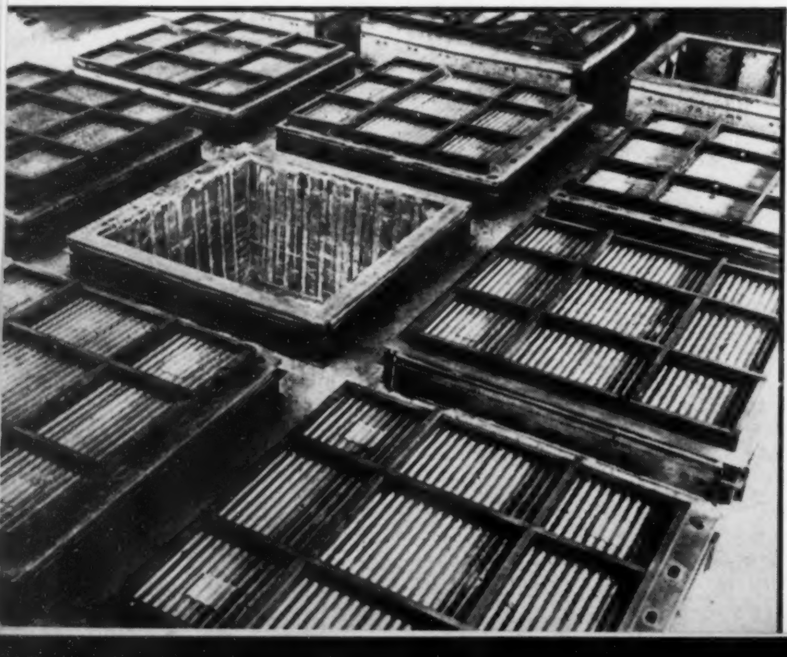
The pits are built 3 holes to a battery, each hole being 4 ft 4 in. wide, 7 ft deep and 60 ft long and having division walls which permit any section of the pit to be used at one time. The pits are built of red brick walls with a concrete floor and are covered with removable steel covers which are constructed of two plates with 4 in. of mineral wool in between.

The material is charged in coils when the outside of such coils appears black and the inside of the coil a dark red heat. The coils are allowed to slow cool for 48 hours to approximately 300 F when they are discharged. No controls are used and the time cycle depends entirely on natural radiation.

On this mill the second type of cooling facilities used are for bars 3 in. to 8 in. in diameter in commercial lengths. This material is sold directly off the mill to the trade for fabrication and there are two reasons for slow cooling such material, the first being to soften for machining and the second to meet the physical properties in ductility to meet customers' specifications. Most of this material is used for shafting. The increase in ductility is obtained without decreasing the tensile.

The material is charged in the pits to about 1200 F as there is great danger of distortion if charged at a higher temperature, but even at this temperature the material has to be very carefully handled when being charged into the pits. The cooling cycle ranges from 48 hours to 4 to 5 days, depending upon the tonnage charged and the material is discharged at about 300 F. Each pit is 6 × 6 × 40 ft long and has a capacity of approximately 40 tons, movable bulkheads being used for smaller capacities.

Figure 2 — Slow cooling pits for forgings. Open pit shows refractory concrete walls. Pits have wall thickness at top of 12 inches and 20 inches at bottom.



In 1943 our company built cooling pits for axles in accordance with purchaser's design as shown in Figure 1. These pit walls were constructed of firebrick laid in fire clay and the covers were of structural design with 3 in. of granulated slag. A simple type of pipe burner was originally placed in the bottom of the pits with the idea of being able to more accurately control the drop in temperature, but these burners have been abandoned as they were found unnecessary.

The axles as they come from the mill are loaded into cradles and the cradles are then charged into these pits, the temperature of the axles when charged into the pits being from 1400 to 1500 F and they are cooled to a range of 250 to 350 F in 72 hours, for material above 50 points carbon. On material below 50 points carbon the charging temperature varies from 1000 to 1700 F and 48 hours are taken to reduce the temperature to from 350 to 300 F.

Structurally these pits were not entirely satisfactory as at the temperature which they operated, the fire clay did not fuse but became powdery, and due to this plus shocks and blows the brickwork became very loose causing high maintenance. To overcome the difficulty, this particular plant next designed and installed pits with the walls built of Lumnite cement concrete as shown by the photograph of Figure 2. The covers on these pits were also redesigned and constructed of structural materials with transite sheets. This latter construction of pit has proven very satisfactory from a maintenance standpoint and the results are the same as those from the first pits installed.

The foregoing gives representative examples of the non-fired cooling pits being utilized today.

The following topics in this paper describe cooling furnaces which have auxiliary firing, since with certain classes of steel, reheating after a period of cooling must be done.

At one of the largest alloy steel plants, where a typical product is an 8 × 8 in. bloom of high alloy steel, they heat treat such blooms before charging them into slow cooling pits. The blooms are taken from the mill cooling bed and are charged into old fashioned type box annealing furnaces where the blooms are allowed to cool to 1250 F. They are then discharged and allowed to cool in the atmosphere to 900 F. In some instances this air cooling is by means of forced draft. After the blooms have been cooled to 900 F, they are again placed in the box annealing furnaces and raised in temperature to 1400 F when they are again discharged and allowed to cool in the atmosphere to 900 F. Afterward they are placed in cooling pits of brick construction and allowed to slow cool in such pits for from 72 to 90 hours. They charge an average of 50 tons of blooms to each pit.

At a western Pennsylvania steel plant they have a pit which is over and under fired, as shown in Figure 3. The furnace is 40 ft long, 8 ft 6 in. wide and 7 ft 8½ in. deep, and is equipped with 13 top and 13 bottom gas burners. The average charge in this furnace is from

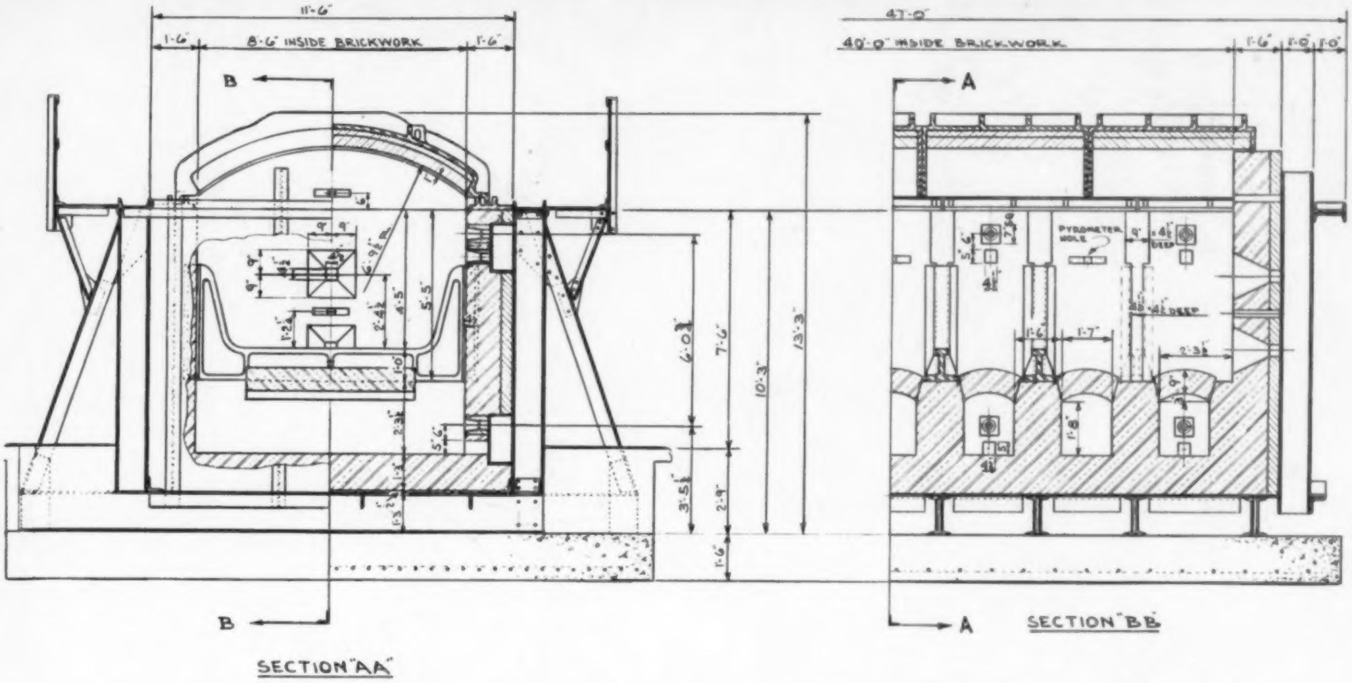


**Figure 3 — Section of annealing and slow cooling furnace for a 24 in. bar mill. Pit is over and under fired.**

60 to 90 tons but a maximum of 125 tons can be charged if necessary, depending of course upon the dimensions of the material. The cycle for this furnace is described as follows. The billets or blooms are left outside until they have lost their color. They are then charged into the furnace and soaked out to 600 F, the soaking time used being determined as follows: Soaking time in hours equals smallest dimension in inches plus two hours.

This gives 12 hours for 10 × 10 in. sections, 16 hours for 14 × 14 in. sections, and 9 hours for 7 × 8 in. blooms.

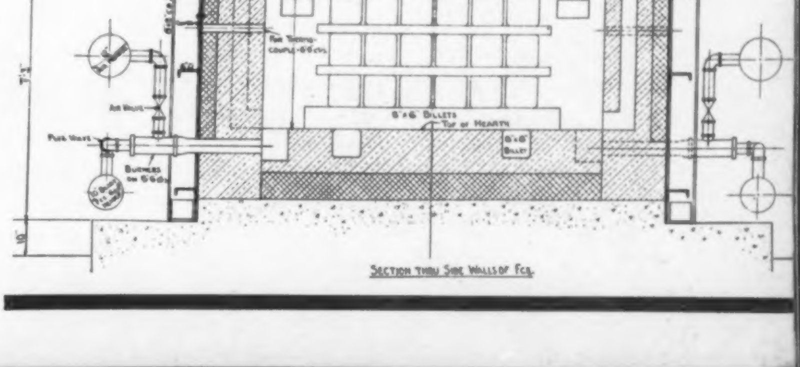
After this soaking time the material is rapidly brought up to 1200 F in approximately 8 hours. The material is then soaked at 1200 F for the same length of time as it was soaked at 600 F; then the furnace is shut down and the material allowed to cool to handling temperature which takes about six hours.

An average of about 1000 tons of steel per month is obtained from each of these furnaces.

In early 1943, our company was commissioned by one of its clients to investigate and submit a complete report on the slow cooling of alloy steels. The investigation showed that the procedure and equipment utilized by one steel company was best suited for their needs. This plant had a total of six furnaces similar to that in Figure 4, which treated 30,000 net tons of steel per month. Two of the furnaces are 96 ft long, two 116 ft long and two 136 ft long, all arranged to be selectively chambered by means of portable bulkheads. The average material for treatment is composed of 9 in. by 9 in. blooms of varying lengths which are grouped according to length for charging. A row of 6 blooms 54 to 60 in. wide is placed lengthwise on the hearth resting on the 6 × 6 in. cross support blooms occurring at 6 to 8 ft centers; 2½ in. by 2½ in. billets approximately 5 ft 6 in. long are laid crosswise on top of the row of blooms to act as support for the next row of blooms. The pile is built up in this manner with alternate rows of blooms and billets reaching a maximum height of 94 in., leaving a 6 in. clearance to the under side of the covers. The bulkheads are then placed to suit the group length of stock to be treated, after which the covers are placed on the furnace ready for starting the treating cycle.

A scheduling black board is located at each furnace and is marked off similar to a plan view of the furnace showing the furnace divided into 7 ft zones. Bulkhead placement is shown on the schedule board. Chalk is used to show the sizes and number of pieces, tonnage and composition of the charge. Time of charge is noted and likewise the treatment order is set down. This schedule board reveals similar data for each group of multiple charges in any one furnace.

**Figure 4 — Section of slow cooling pit used for cooling alloy steel. Pit has capacity of 5000 net tons a month.**



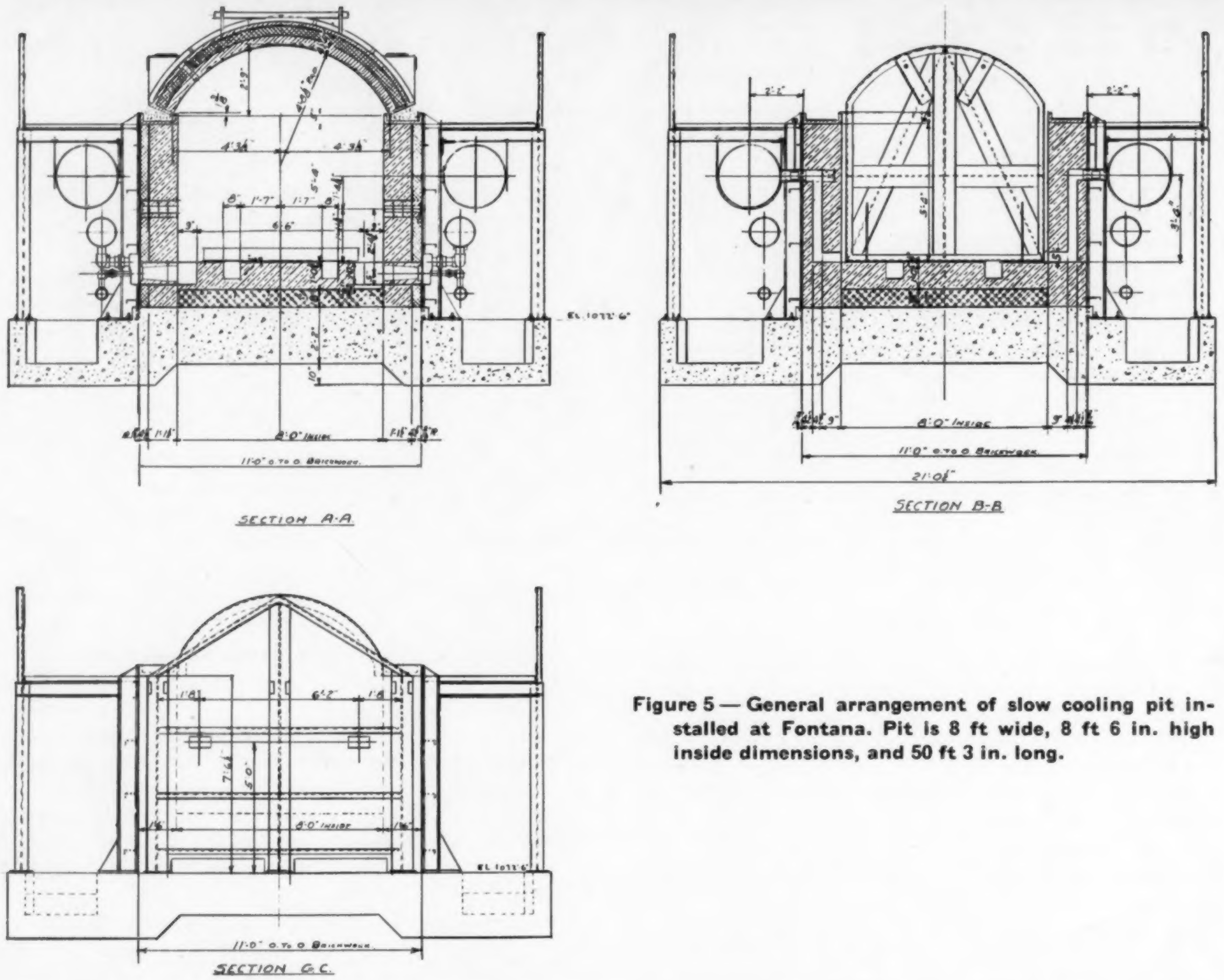


Figure 5 — General arrangement of slow cooling pit installed at Fontana. Pit is 8 ft wide, 8 ft 6 in. high inside dimensions, and 50 ft 3 in. long.

The steel in the form of blooms and billets after slow cooling to prevent flake is conditioned for scarfing, and with a chrome manganese molybdenum steel, the material is charged into the pits at approximately 1900 F, cooled by natural radiation with the pit covers off, to from 600 to 700 F. The covers are then replaced and the temperature held at 600 to 700 F for sixteen hours. After this period, the steel is reheated to 1200 F and held at this temperature for twenty-four hours when it is drawn and allowed to cool in the atmosphere.

This procedure is approximately the same for most SAE series steels manufactured at this plant.

Most National Emergency series steels are charged into the pits at from 700 to 1200 F and are held at the charged temperature for from eight to twelve hours when they are drawn and cooled in the air. Of course, there are certain exceptions to this, but these appear to be few.

The slow cooling pit serving the alloy mill at the Kaiser plant at Fontana, California, is designed and constructed as shown in Figure 5. This pit is equipped with auxiliary gas firing and facilities for cooling and collecting the waste gases and discharging them outside the building. The pit is 8 ft wide inside, 8 ft 6 in. high from the inside of the cover and 50 ft 3 in. long. This pit is underfired by 18 burners with 9 on each side. The pit is constructed with removable covers in sections and also removable bulkheads. These bulkheads are utilized to provide the desired length of chamber for the material being charged.

The material to be treated is 8 × 8 in. blooms up to 20 ft long and rounds 5⅛ in. in diameter up to 30 ft long of all alloy grades. The pit, in addition to being suitable for slow cooling, is also adaptable for annealing.

The burner capacity is such that a 200 ton charge of 8 × 8 in. billet stock can be reheated at a maximum rate of 100 F per hour. Two recording potentiometers with 24 thermocouples, 8 for insertion through the bungs and 16 through the walls, were installed.

It appears that the time necessary to cool a piece is considerably shortened by using a furnace where the cooling cycle can be controlled. In one instance a bloom 14 × 14 in. took 10 days in a slow cooling pit and a similar piece in a controlled temperature furnace was processed in approximately 48 hours.

In all the cases mentioned, the material handling is a real problem necessitating special equipment and therefore the tendency now appears to be the installation of car type furnaces.

## DISCUSSION

PRESENTED BY

**F. L. BECKER, Mill Metallurgist, Republic Steel Corporation, Massillon, Ohio**

**GEORGE RESSLER, Timken Roller Bearing Company, Steel and Tube Division, Canton, Ohio**

**C. G. BIGELOW, Assistant Engineer, Loftus Engineering Corporation, Pittsburgh, Pennsylvania**

**M. H. MAWHINNY, Salem, Ohio**

**R. L. STEPHENSON, Assistant Chief Metallurgist, Carnegie-Illinois Steel Corporation, Duquesne, Pennsylvania**

**F. L. Becker:** In the Massillon plant of Republic Steel Corporation we are using both pits and furnaces to treat our steel for the prevention of flakes, and our trend has been toward furnaces. We have found that this is the most foolproof method for the treatment of steel for the prevention of flakes.

**George Ressler:** At Timken, we do practically all our cooling in pits. They are of refractory brick construction with steel slabs. Of course, we have the same trouble everyone else has in their construction, namely expansion and warpage due to the hot steel which causes shearing, and that does more harm than anything else. The possibility of new material might improve the life.

**C. G. Bigelow:** It seems that slow cooling of steel is necessary in about three cases. The first is where mechanical cracks occur due to strains in the steel, which usually occur with steels which air-harden to a Brinell of 400 or greater.

The second case and the most important to us at the moment is the business of preventing flaking in alloy steels. That was particularly important during the war.

The last use we have for slow cooling is in obtaining workability, and this specification is sometimes required by the manufacturer himself and other times by the customer to whom he sends the product.

On this problem it seems that we should use a simple answer for a simple problem and most people do use pits for simple slow cooling today. However, the metallurgist wants a more flexible tool in order to do his problem better and faster, and the car type furnace may be a possible all-around answer to the metallurgist's problem.

**M. H. Mawhinny:** The subject of cooling pits has been very much neglected. Most of the discussion of that important subject has been on the metallurgical aspects and very little on the equipment required for doing the work. The authors have divided the subject conveniently into two parts, pits without burners and those with burners.

The principal problem on the pits without burners is to construct them sufficiently strong to withstand the battering of blooms, ingots, billets, and other pieces of steel in large and heavy form.

I agree that heavy steel slabs combined with rammed refractory material frequently gives the best answer.

The pits equipped with burners should be called by a better name. In order to accomplish the results properly on those steels which require a cycle anneal, the pit must really be an annealing furnace and should be considered as such. The tendency is to build cooling furnaces cheaply and without much thought, simply because they are cooling furnaces, whereas actually they are annealing furnaces and should be designed to give the maximum uniformity in addition to the maximum strength that is necessary to withstand the heavy pieces that are handled.

**R. L. Stephenson:** We have been slow cooling blooms and bars in railroad cars and slow cooling pits for years and are not contemplating installing car bottom furnaces to replace them. This change brings up the problem of building an even pile of hot blooms on the furnace car. Although it is relatively easy to pile a large number of hot blooms down in a pit it is considerably more difficult to stack them up even enough so that the car bottom furnaces will be loaded to capacity.

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# Modern Conveying Systems
## IN STEEL PLANTS

***. . . . among the unique features of the Fontana and Geneva steel plants are their methods of handling materials . . . . belt conveyors are used extensively through the plants and their unique features result in developments and procedures worthy of note . . . .***

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▲ THIS paper is a discussion of the materials handling systems developed by the infants of the steel industry in the west, the Kaiser Company, Inc., Iron and Steel Division, and the Geneva plant of the Defense Plant Corporation. Generally speaking, the only fundamental difference in the systems at Geneva and Fontana is that Geneva handles everything but their limestone on belts, whereas Fontana uses belts for everything. There are of course variations in belt sizes, speeds, etc. inherent in any two installations tailored to fit specific requirements. We have used the Fontana plant figures as a basis for our discussion since it is more completely "conveyorized" and goes further into vulcanized repair and maintenance of belt conveyors.

Much has been written about the general layout at Fontana. Quite probably the thought is lurking in the back of the heads of many that, if given a spacious location on level ground and without the necessity of space or contour limitations with which we are frequently faced in plants that have grown up and expanded over a long period of years, we too might plan a layout for a steel plant operation more nearly ideal than could possibly have been developed from plants that grew and had to accommodate themselves to many handicapping features of environment. The Fontana layout, however, was not the result of years of planning, but rather represents the accumulated experience of the engineers and operators drawn from the steel industry and from the ranks of various Kaiser enterprises. These men brought to the enterprise a long and successful background of projects that required the handling of enormous volumes of bulk materials. In these projects they had developed, to a high degree, bulk materials handling systems on belt conveyor units, and had proved the efficiency and economy of such methods.

Figure 1 shows the Sunnyside coal seams at Sunnyside, Utah, some 650 miles distant from the plant. The coal seams are worked in the conventional manner of undercutting and blasting by the normal room and pillar method. The coal is brought to the surface at the tipple, crushed to minus 8 in. in roll crushers, screened, and then picked, washed, and blended for shipment. All of these processes follow conventional methods. Shipment is by rail over the Union Pacific Railroad to Fontana. Much of the tonnage is handled into the plant on Santa Fe rails and there are direct connections with the Southern Pacific as well.

The principal source of ore is from the Kaiser owned Vulcan iron mines as shown in Figure 2. However, ore is also being used from mines west of Cedar City, Iron County, Utah, and future developments may open up

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deposits in the Iron Mountain Range in the eastern part of Riverside County, California, which latter deposits are within about 150 miles of the plant. There are many additional small iron deposits within a range of 300 miles of Fontana, as well as other deposits on the west coast of Mexico. The fact that these western deposits are not as big or as uniform as our eastern ores necessitates the bedding systems to blend the ore.

At the Vulcan mine there is very little overburden and the ore is therefore easily removed by open pit mining methods, being worked in 40 ft benches, each bench divided into blocks which are the actual mining units. The method of blasting that has been developed furnishes good fragmentation of the ore and therefore requires a minimum amount of secondary drilling and blasting. Ore is loaded by diesel shovels into 10 yard pit trucks. These trucks dump directly into a primary crusher bin. The maximum shuttle haul is 1000 ft to the bin. Ore from the bin passes over an apron feeder to a sloped grizzly having 8 in. openings. The undersized material discharges directly onto a 42 in. cord conveyor belt, spliced endless. Both undersize and crushed ore are conveyed over a cantilever to a live stockpile of approximately 7000 tons capacity. There is a tunnel under this stockpile having a 42 in. apron feeder and conveyor belt which feeds directly into a fleet of semitrailer trucks. The trucks haul a 25 ton load 8½ miles over paved road to the Union Pacific railroad at Kelso. The truckloads are dumped into a receiving bin from which the ore is taken by another 42 in. apron feeder and a 42 in. 6 ply cord endless conveyor belt, on 70 ft centers and having a capacity of 333 tons per hr, where it is automatically weighed while being conveyed and transferred into rail gondolas having allowable load limits of 60 to 70 tons. Approximately 1500 tons of ore per day are produced from the Vulcan mine and this amount can be increased with the present equipment.

It is after the ore reached the plants that the unusual handling methods become evident. In most steel plants the ore is received already crushed and stock piling is usually done by unloading hopper bottom cars, run onto trestles where the load is dumped, the different ores from different mines being stock piled separately and then blended by selections of varying quantities from different piles when the ore is reclaimed and passed to the furnace stock bins. Usual reclaiming is by use of clam-shell buckets, operating from a bridge over the stock piles.

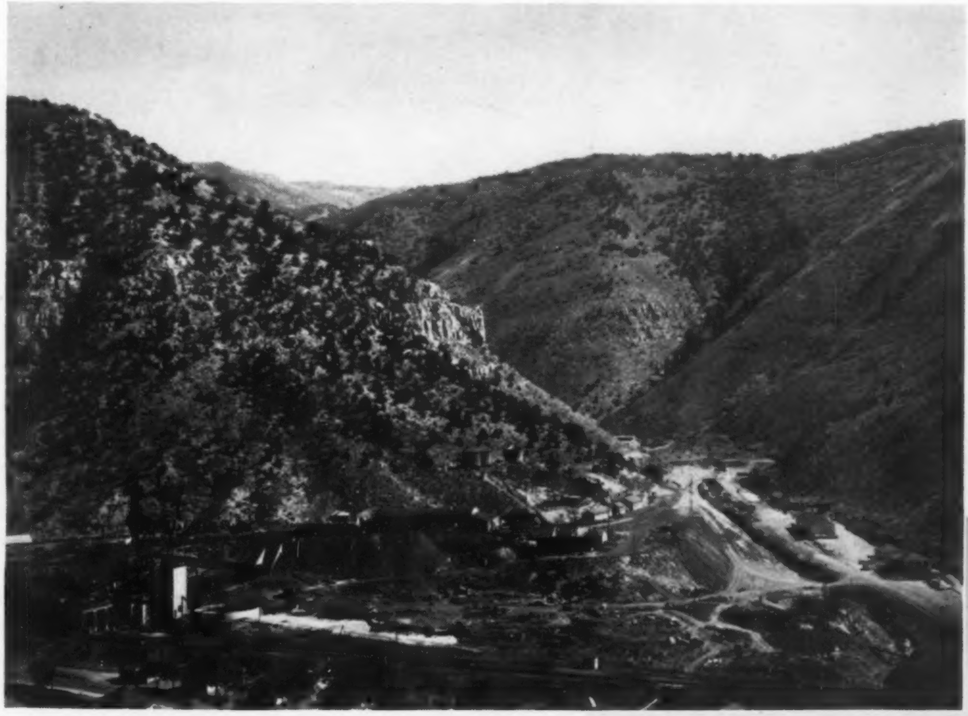

**Figure 1 — Panoramic view of Sunnyside coal seams at Sunnyside, Utah.**

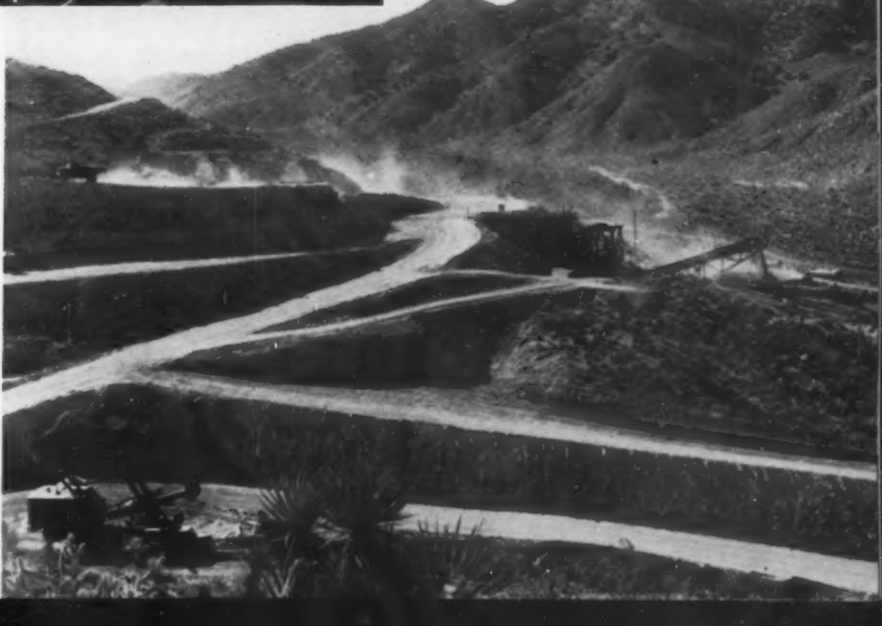

**Figure 2 — View of Kaiser owned Vulcan Iron Mines.**

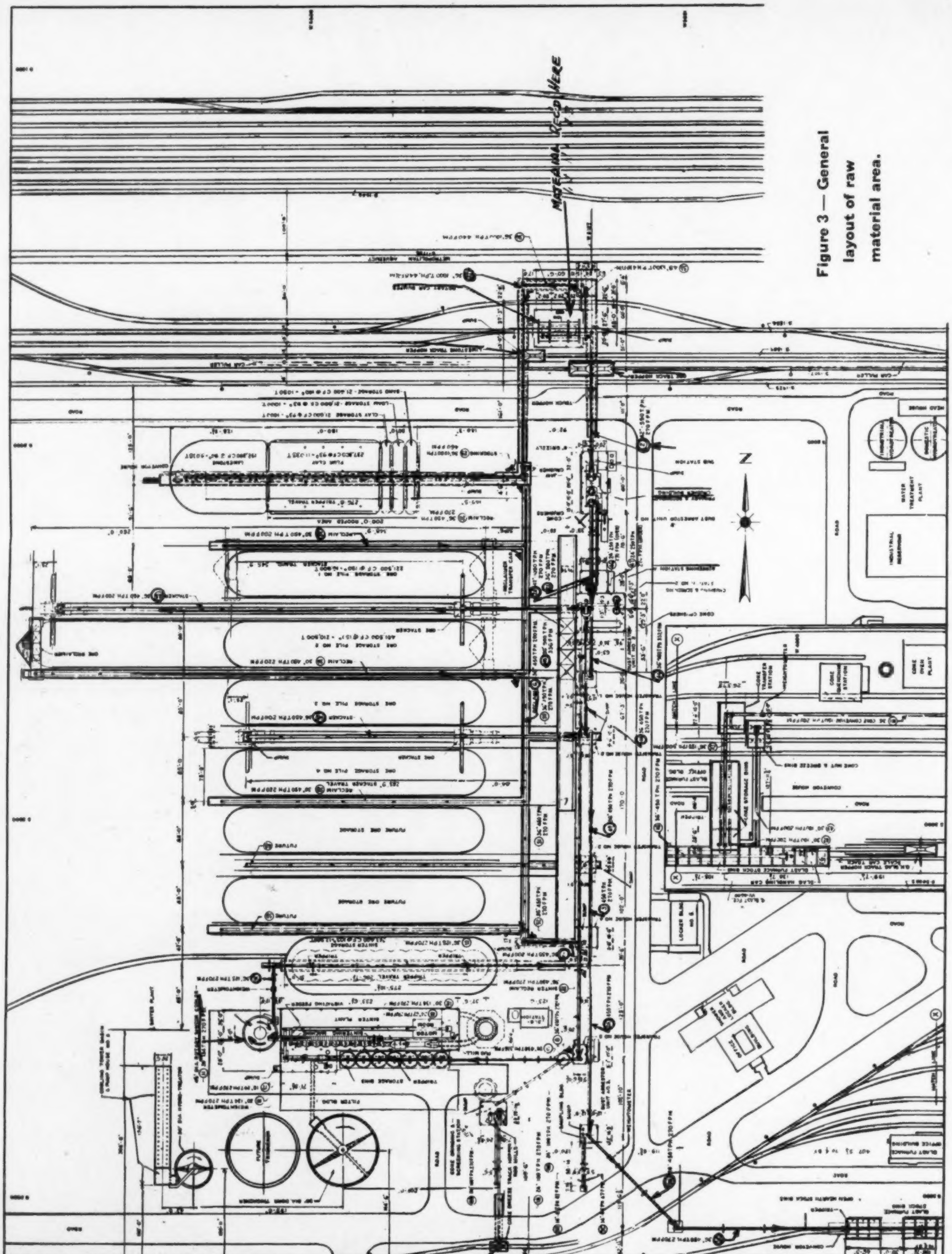
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Figure 3 — General layout of raw material area.

At both Fontana and Geneva the blending of the ore to take care of the natural variations in the grade is accomplished by the bedding system which on the plant layout (Figure 3) is indicated as the ore stock piles. With the bedding system, the ore is distributed in horizontal layers by stackers. The ore stackers are self-propelled units, each stacker having two booms capable of handling a pile of ore on either side of its runway. The machine is literally an oversized tripper on the conveyor belt, but the tripper discharges onto the conveyor belts on the booms. These booms distribute the material onto the pile or bed. As they progress lengthwise of the pile, they lay down a uniform layer of possibly 8 in. to one foot thick. Then they return down the length of the pile, continuing to discharge a second layer. They progress back and forth in this manner until the ore pile has reached the storage capacity which is of course determined by the angle at which the ore naturally assumes as it is dropped from the boom belts.

The ore reclaimers, of which there are two, act as oscillating rakes which scrape a cross section from the end of the pile. This loosened material runs down the pile to the conveyor belt on the reclaimer machine, which, of course, discharges it to the gathering belts No. 4 or 4A. When the reclaiming machine has reached the end of a stock pile the machine itself can be moved to another of the four piles by means of a transfer car at the easterly end of the stock pile. A very satisfactory blending of the ores is achieved when the reclaiming machine which works as a harrow back and forth across the entire cross sections of the pile cuts through the stock, and portions of all the differing strata are raked onto the reclaimer belts for conveyance to the blast furnace stock bins.

Unloading of the railway cars arriving at both Geneva and Fontana is done by means of a rotary car dumper as shown in Figure 4. Within 1¾ minutes after the car is placed in position on the car dumpers, it has been upset, the load discharged, and the car returned to normal position, ready to be taken off the car dumper by the switching engines and replaced with another car. Upwards of 20 cars per hour can be handled. At Fontana the load is discharged into two hoppers which have feeder bottoms delivering it directly onto a 42 in., six-ply cord conveyor belt with an operating capacity of 550 tons per hour. This belt is shown on the plant layout as conveyor No. 2. It operates below ground level, but in its running length of 168 ft it lifts the ore 35 ft to the primary crusher. A truck hopper is provided between the car dumper and the primary crusher so that truck loads can be handled. There is a note of caution on the belt loading from this type of hopper. The standard chute and hopper opening need adjusting to insure no material drop directly onto the belt. In handling sticky ore this cannot always be fully accomplished without danger of chute clogging, and so the use of cushion idlers under the belt is dictated.

Conditions on this specific conveyor showed the necessity for these after the first operation. As soon as it was possible to make the adjustments and install the zero pressure idlers, this was done with marked improvement which has saved several times the cost in reducing belt destruction.

Figure 5 shows, in the series of buildings from right to left, the crusher plant and the transfer points and dust collector stations on the belt system. The building in the right foreground is the blast furnace office building.

The crusher is jaw type, crushing to approximately minus 5 in. The ore next passes over a vibrating screen which delivers plus 3½ in. and minus 3½ in. sizes. The over-size from the screens is again crushed in two cone crushers which deliver a product under 3 in. size. Conveyor No. 2-A receives the discharge from these crushers. It is a 42 in. six-ply cord carcass conveyor belt with a capacity of 1050 tons per hour. It elevates the material 39 ft within a center distance of 168 ft where it is discharged into the secondary crushers and carried to the screening station A, where over-size material is returned by means of conveyor belt No. 21 to the crushers for reprocessing. From this point we have another advantage of the system in that the ore can either be fed directly to the furnace stock bins by traveling over the series of 8 conveyors or it can be transferred to lateral belts and delivered to ore storage or stock piles. These are all 36 in. belts delivering 450 tons of material per hour.

From screening station A, the ore travels on conveyor belt No. 3 which is a 36 in. five-ply cord belt, 474 ft long

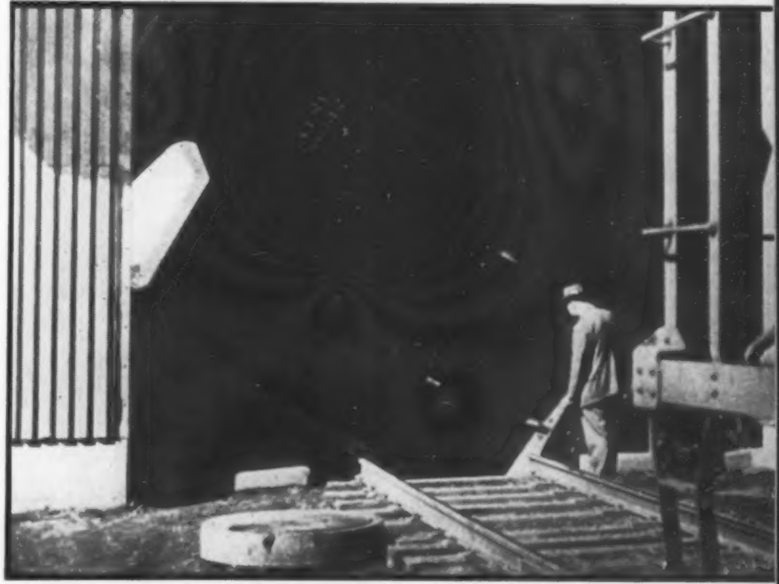

**Figure 4 — Cars at Geneva and Fontana are unloaded by means of a rotary railroad car dumper.**

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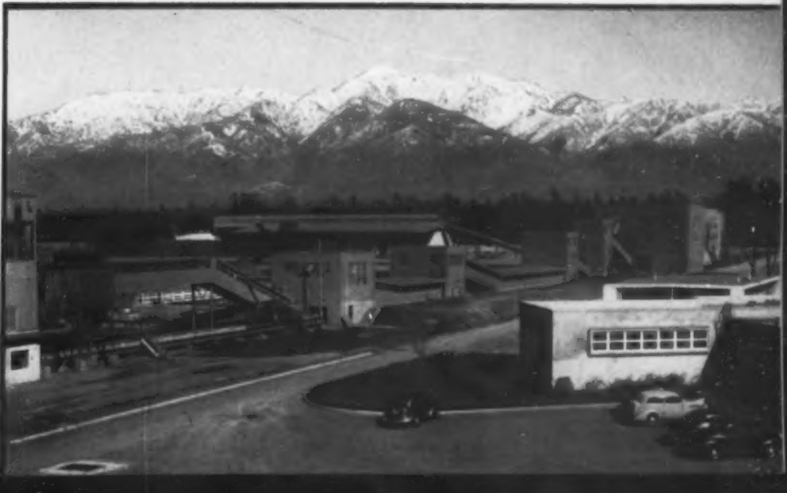
**Figure 5 — View of belt conveyor system from top of furnace. The ore bedding system is in the right background.**



with an overall lift of 9 ft. This belt has a capacity of 550 tons per hour.

By means of transfer stations shown on the plant layout diagram, Figure 3, the ore can be diverted to the lateral belts feeding the ore stackers shown as belt Nos. 4 and 4-B. Both of these belts are 36 in. six-ply, 42 oz fabric carcass. No. 4-A has an operating center length of approximately 700 ft with a rise of 30 ft. It delivers 550 tons per hour to storage piles by means of the ore stacker.

Figure 6 is a view taken from the top of the blast furnace. It shows the belt houses and transfer stations to the last dust collector unit located in the center foreground in front of the sinter plant chimney. Again returning to the right edge of the figure and to the background beyond the lateral belt system, the ore bedding piles and the two stackers can be seen. The square building to the left of the dust collector unit is the automatic ore sampler unit. In the right foreground is the blast furnace office building.

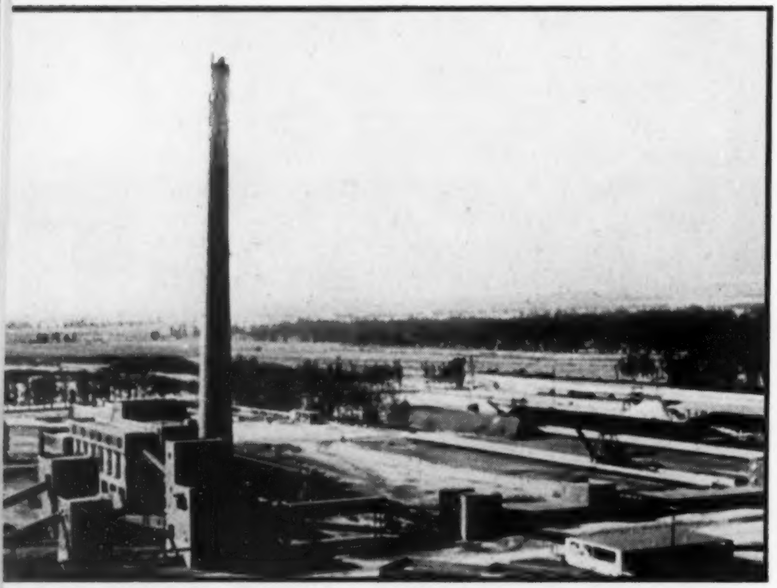


**Figure 6 — Bird's-eye view of belt houses and transfer stations. The dust collector unit is located in the center foreground in front of the sinter plant chimney.**

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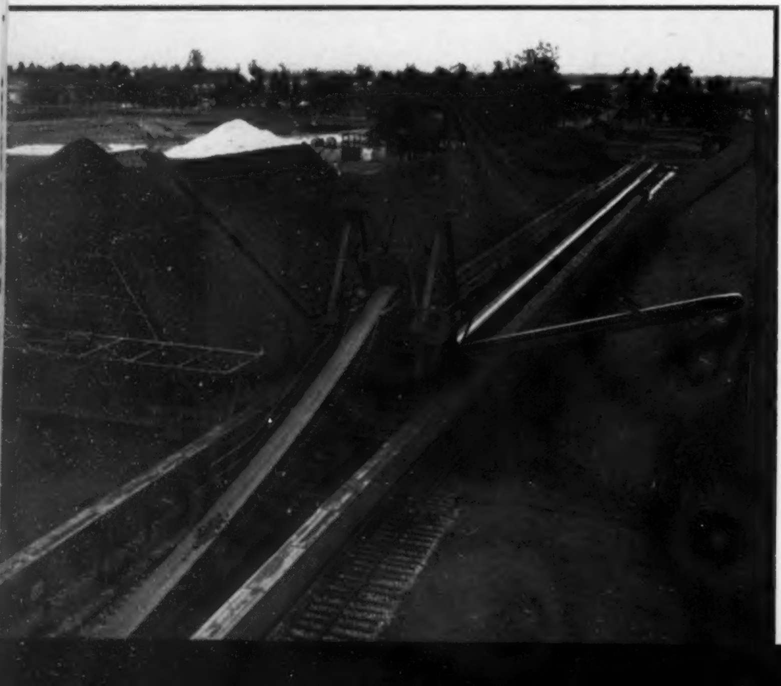
**Figure 7 — One of the ore stackers. Each ore pile normally has a storage of about 15,000 tons per pile.**



The normal ore storage is approximately 15,000 tons per pile and with the normal four piles represent a 60,000 ton storage. An area beyond pile No. 4 sufficient to accommodate two additional and similar piles is available when required. The capacity of stock pile No. 2 is greater than that of the others to accommodate manganese ore at the far end of the storage pile.

There are two ore stacker machines regularly operating and each machine has two booms. Figure 7 shows one of the ore stackers. Again we find the use of conveyor belting facilitates the handling of the mass and permits continuous operation. The belt equipment of the booms is 36 in., six-ply, 32 oz fabric carcass.

When the ore is reclaimed for delivery to the furnace stock bins, it is handled by a reclaiming machine which has an inclined oscillating rake arrangement that removes a cross section of the ore storage pile, as shown in Figure 8.

The reclaimer delivers the ore to reclaim belts No. 5-A or 5-B, according to the particular pile from which they are working. These belts are each 30 in., six-ply, 28 oz duck carcass construction. They have a rated capacity of 450 tons per hour.

The reclaim material is then transferred to belt No. 6 which parallels the operation of the main flow of material as described on the system from the crushers through to the stock bins. The No. 6 belt is a 36 in., five-ply cord on 820 ft centers with a capacity of 450 tons per hour. Transfer from the end of the No. 6 belt system onto the No. 3-A belt is by means of conveyor No. 7 which also is a 36 in., five-ply cord. This latter system has a center length of 80 ft, and of course operates at the same speed and capacity as No. 6.

The limestone, flux and manganese ore are delivered to the plant either in railroad cars or truck loads. They are received either through the rotary car dumper or through the truck hopper discharging onto the belts operating from the car dumper station. These materials are diverted to a 48 in., seven-ply, 32 oz fabric carcass belt which transfers it to a 36 in. lateral belt where it is conveyed on an underground system beyond the car dumper house, making a second transfer at this point to a 36 in., 6-ply fabric belt. This system operates below the limestone truck hopper and at a third transfer point delivers the material that is to be stocked to a 36 in., 5-ply cord conveyor operating on 448 ft centers with a rated capacity of 1000 tons per hour. Trippers installed on this system make possible the selection of the storage points for the various materials.

The material from any of these storage piles is reclaimed onto a belt system operated in a tunnel below the storage pile. Hopper gates beneath these piles permit the control of material to a shuttle car on which is mounted an apron type feeder. The feeder discharges onto a 36 in. five-ply cord belt operating with a rated capacity of 450 tons per hour. The reclaimed material is transferred to the No. 6 belt, which is the one previously described as receiving the reclaim from the stock piles.

Figure 9 pictures the sinter plant. Fine ores and coke breeze are carried by the conveyors to the sinter bins of which there are a total of seven. Each bin has a total capacity of 496 tons when filled with ore or 142 tons

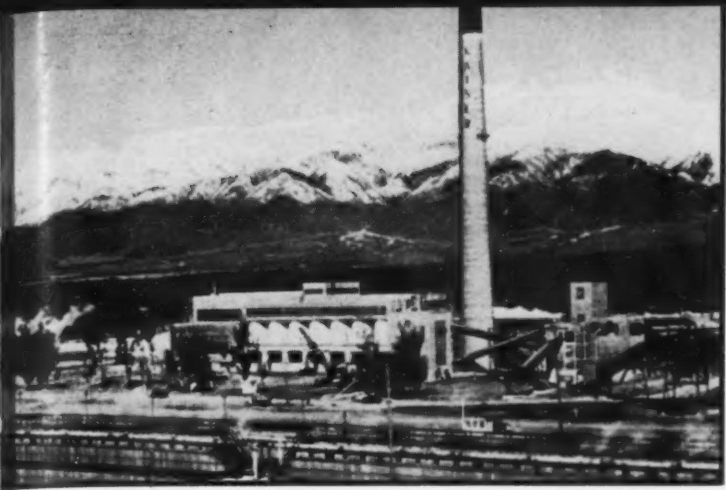


**Figure 8 — Ore reclaimer consists of an inclined oscillating rake arrangement that removes a cross section of the ore pile resulting in the required ore blend.**

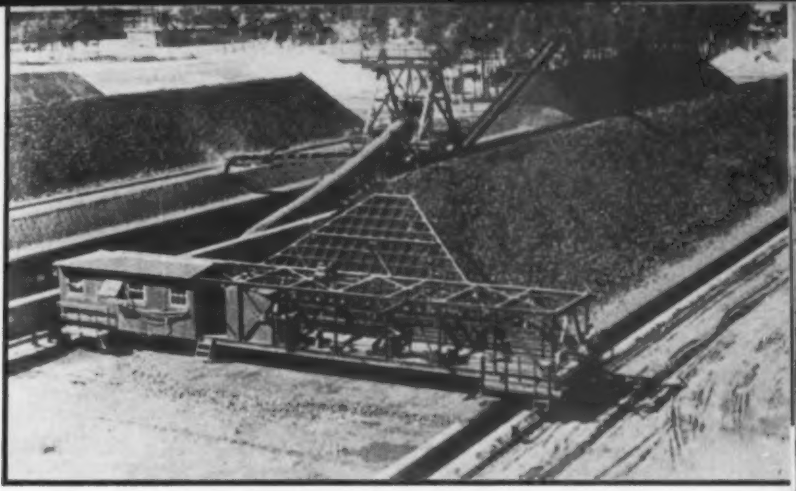


**Figure 9 — Overall view of sinter plant.**

per bin when filled with coke breeze. The ore fines are all minus ¼ in. Coke breeze is minus ½ in. as produced at the coke plant, is crushed in a Marcey rod mill and then rescreened. The minus ⅛ in. breeze after this crushing provides the fuel for sintering. The bins are in themselves an integral part of the sintering plant building.

Further material for use in the production of the sinter is obtained from the precipitates gathered from wash waters from the dust collector units and from the furnace blast. A dual purpose unit is the installation of an electro-static precipitator in the air intakes of the blowers. One purpose of these precipitators is to reduce the cutting of the blower impellers by sand carried along on the winds in the area, which frequently reach 40 miles per hour or more and whip up debris from the surrounding territory. The dust collected by the precipitators is carried through a wet washer to a 90 ft diameter thickener. Sludge from the thickener is made into a "cake" which is fed, with fine ore, dry flue dust and coke breeze, to the pug mill and then on to the sintering machine. The setup is so arranged that the sludge from the thickener can be pumped directly to the sintering plant. The sintering plant has a capacity of 1500 tons per day.

From the storage bins, the ore fines and coke breeze are fed to mixers which discharge onto conveyors that feed the sintering machine. The ignition furnace burns by-product gas at a gas pressure of 1.75 psi.

There is another extremely interesting piece of equipment that has been developed at the plant for handling sinter cooling. We all know the headaches that the handling of extremely hot material causes plant men. The rubber industry is frequently called in for recommendations for types of conveyor belts or constructions to do the impossible, such as to offer a conveyor belt made of rubber and cotton, both of which burn, to convey red hot and sometimes flaming sinter or hot coke. Although good hot materials conveyor belts have been developed, the best solution for longer and more satisfactory belt life would be to find a means of materially reducing the temperature of the sinter or coke before it is delivered to the belt.

To reduce the sinter temperature, a machine was designed that receives the sinter on a slowly revolving platform 46 ft in diameter. The red hot sinter is deposited on the top of the bed of material that has been built up to some 4 or 5 ft in thickness. As the machine revolves, a plow placed about 340 degrees from the loading point scrapes off the bottom layer about 8 in. to 10 in. thick. This, of course, permits the material above to drop on down, so that if we could follow an individual piece of material from the time it is deposited on top of the load until it is worked down to the plow, we would find that it had made about six revolutions in an elapsed time of four to six hours. Meantime its temperature would have dropped from flaming hot to less than 150 F. This lower temperature material is much more satisfactory to handle on the receiving belts. The life and wear factors of the belts are very materially increased, besides reducing accident hazards in the plant in handling the hot heavy sinter.

The sinter is now carried on a special hot materials cord conveyor belt to the sinter storage piles which parallel the ore storage piles. The sinter is reclaimed onto belts operating in a tunnel below the piles.

As the various materials are collected for charging the blast furnace, they are all brought together on the system of belts as described, and when the ore passes through the sampling building a cut is taken from the moving material at intervals of approximately 4 to 5 minutes by an automatic sampler.

Within an hour after the samples reach the laboratory, the analysis of the ore or of the limestone is available at the blast furnace office, the information having been transmitted and recorded by a telautograph system.

All of the material is automatically weighed by the weightometer as it is carried along on belt No. 3-B from the transfer point in the sampling building to its discharge on belt No. 16 that operates over the open hearth stock bins and the blast furnace stock bins. Ore or other materials are diverted from the No. 16 belt by a self-propelled tripper into any one of the stock bins, thereby permitting stocking of limestone, coke, ore, or manganese in individual bins. The usual type of scale car operates under the stock bins collecting the required tonnages for the furnace charges.

Figure 10 is an all inclusive view of the battery of coke ovens with the coal and coke handling systems in the background and foreground.

There is probably no coke plant man who has not at one time or another tried his hand at the all-absorbing problem of getting better belt life. The problem is

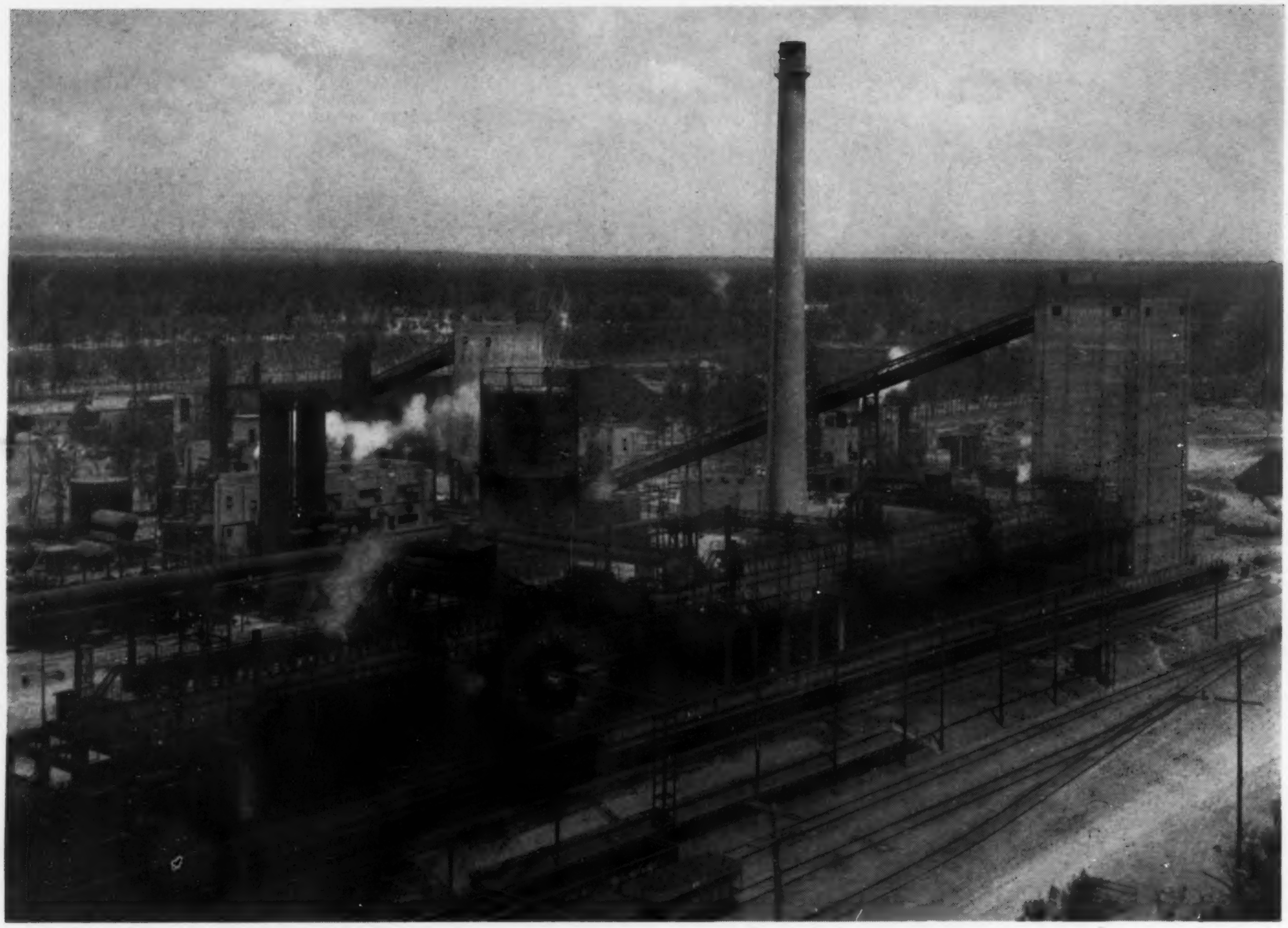


Figure 10 — Battery of coke ovens with the coal and coke handling systems.

always complicated by the 90 degree angle feed on wharf belts and the consequent "off center" loading that results. The "turnable conveyor" invented by D. P. Finney, assistant general superintendent, Clairton Works, Carnegie-Illinois Steel Corporation, is worthy of more than passing comment. Briefly, this belt is so constructed that the wear factor is virtually doubled (see Figure 11). The unique construction in no way lessens the strength or load carrying ability of the belt but distributes the cover to compensate for the wear from off-center loading, resulting in virtually twice the life for the same carcass cost. Care must be taken that the cover wear on the first installation is not allowed to progress to the point of exposure of the carcass. A little difficulty may be experienced in getting the belt to run straight when it is turned over and a few guide idlers or other corrective measure may have to be taken.

The question might well come to mind as to the amount of labor involved in turning the belt. A very simple method has been devised to do this. The method calls for the removal of the lacings of the belt (note Figure 12), putting a twist into it, and then temporarily fastening the ends together. One complete revolution of the belt puts it in the position shown in Figure 13. The belt has now reversed itself and all that remains to be done is to remove the temporary lacings and the twist and finally to install the permanent lacings.

The method of conveyor belt handling of the coal and coke in the plant follows conventional methods In all there are approximately 14,000 ft of various widths of conveyor belts operating in the plant.

The general pattern of the ore bedding system and handling of materials as described in the foregoing is also used at the DPC steel plant operated by the United States Steel Corporation at Geneva, Utah.

The selection of the correct conveyor belt for any particular installation has gone, in the last ten years, from a more or less haphazard procedure to one where the operator can gain materially from consulting a rubber technician. The jobs that conveyor belting are being called upon to perform have grown in magnitude to a point where the design of the conveyor installation and selection of the proper belt are strictly engineering functions. This has developed into more or less an exact science.

You will find the rubber salesmen have at their beck and call a technician ready and willing to go over the layout and engineering data of a proposed installation, to assist by suggestions which will result in the greatest tonnage at the lowest capital expenditure and maintenance cost. There are certain elements to be taken care of before an installation design is finally approved, and the manner in which the belt is loaded, driven, guided and stressed are the most fundamental. In the field of maintenance are a host of operating tricks that the trained rubber man can apprise you of with regard to a specific installation, in the hope that the belt life can be lengthened and consequently the operating cost lowered.

Where severe impact loading conditions and highly abrasive materials are combined with the necessity for having belt carcass tensile strengths necessary to convey heavy loads over average long centers, the belts selected should be of cord carcass construction, as shown in Figure 14.

As to the controversy on the relative merits of different materials for conveyor belts, there are only two applications for which we feel neoprene shows superiority over buna-S. The first is in its resistance to oil, and secondly, it will burn only as long as the source of heat is in contact with the belting. When the heat source is removed, neoprene will not continue to burn, whereas buna-S compounds burn and support combustion much the same as natural rubber compounds. Even on hot coke installations, where burning lumps are occasionally in contact with the belt, we recommend the use of buna-S. Laboratory tests made on neoprene and buna-S, using the same tests that are used as standard for natural rubber compounds, indicate a marked superiority of neoprene over buna-S in resistance to abrasion, cutting and gouging. Basing our thinking on laboratory tests alone, neoprene should be much superior to buna-S in actual service. However, under actual operating conditions to which conveyor belting is subjected, this superiority does not occur, at least to the extent to warrant paying the much higher price charged for neoprene.

We know of several large users of conveyor and elevator belting who have proved to their own satisfaction that buna-S is the equal of neoprene not only on a cost per ton of material handled basis, but on a belt for belt basis. A further advantage of buna-S over neoprene is the fact that the former is less affected by cold weather, which causes the belting to stiffen. Still another advantage is the making of vulcanized splices and repairs, since we can handle buna-S belting the same as natural rubber belting. Neoprene belts require special cements, double the curing time, and in addition more time and skill are required in making repairs and splices.

We have endeavored to educate customers to use heavier covers on synthetic rubber belting than they previously used on belting made with natural rubber compounds. For ordinary service conditions a 25 per cent increase in top cover thickness is sufficient; for severe service a 33 to 50 per cent increase is recommended. As our experience increases we may be able to revise these figures. If we must err in our recommendations we would rather it would be because of too much cover rather than too little.

Our experience shows that buna-S conveyor belting gives service on a belt for belt basis with prewar quality natural rubber belting. Our company has been the strongest advocate of buna-S over neoprene since the rubber industry started using these two synthetics, and we have no reason to revise our thinking at this time.

Rubber or synthetic rubbers offer the most resistance to cutting, gouging, or abrasive wear when they are permitted to yield under the forces set up by loading impacts, and the application of this principle has made cord carcass conveyor belting superior in wear resistance. Due to the cushioning characteristics of cord construction, cord belts yield with little harm under

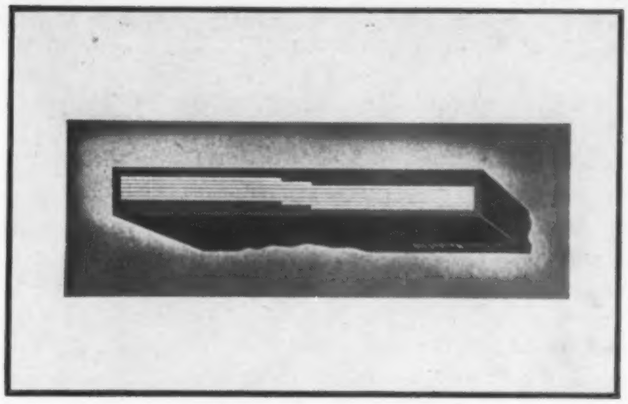


**Figure 11 — Section of turnable conveyor belt showing its unique construction.**

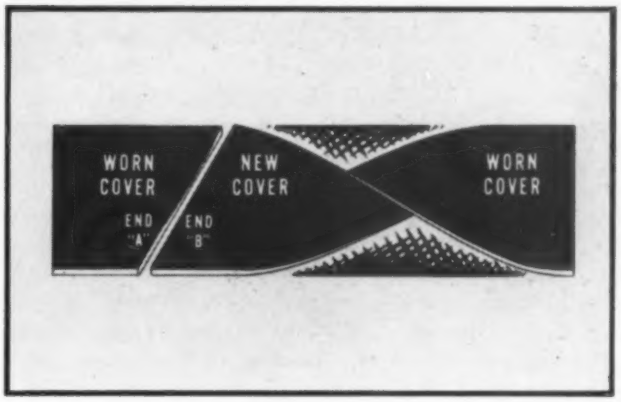


**Figure 12 — Illustrating first step in turning a conveyor belt. The end of the belt is unfastened and turned 180 degrees and then temporarily refastened.**

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**Figure 13 — Illustrating second step in turning a conveyor belt. The belt has now been run through one revolution so that the new surface is now exposed except at the end shown in this figure.**

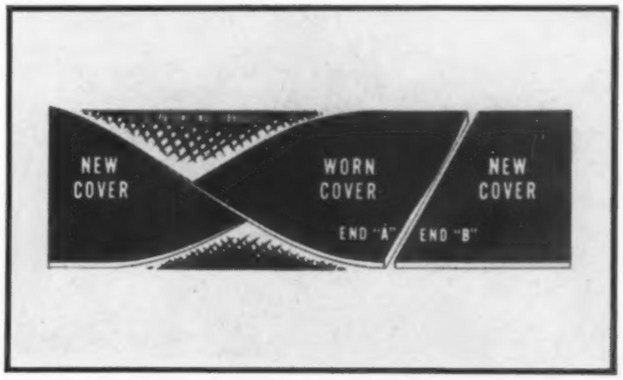
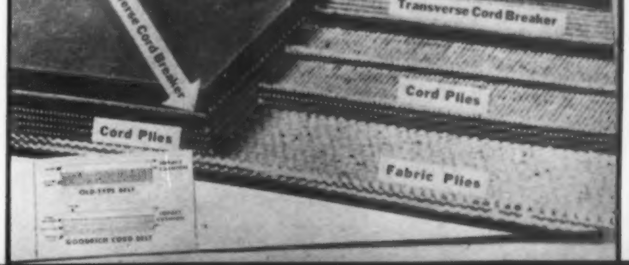


**Figure 14 — Section of conveyor belt showing cord carcass construction.**



heavy impacts that would injure conventional fabric types.

It is of interest to note that the cord conveyor belts generally described herein are similar to the long center cord belt used in conveying iron ore in the Mesabi Mountain pit of the Charleson Iron Mining Company in northern Minnesota and operating with the greatest known vertical lift of any single conveyor belt unit. An interesting detail on this installation is that an estimated 7½ million tons of iron ore remained in the Mesabi Mountain pit when the Charleson Iron Mining Company took over the lease. The bottom of the pit had reached a depth of 400 feet. Conventional ore handling methods made profitable mining impossible. Locomotive hauling, with its easy grades requiring miles of switchback lines, was not practical for this mining job. The best way to get the ore out was with a belt conveyor system, and a three-belt system was first installed. However, maintenance and transfer costs were high — so high that the mine operators started looking for another system. The ideal system called for a single belt. Unfortunately, a single belt of ordinary construction strong enough to handle this tremendous load and lift was not practical. A belt strong enough for the job would have to be so thick and stiff that it could not flex or trough satisfactorily. Excessive spillage would take place, and edge wear, damage to auxiliary equipment, and frequent costly shutdowns would be inevitable. However, when a single cord belt, 1900 feet long was finally installed, it was successful. The cord belt reduced maintenance costs, troughed adequately and accurately, and made economical and profitable mining a reality.

Briefly, the salient installation facts are as follows:

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| **Belt** | **30 in. 8-ply buna-S synthetic cord construction with ¼ in. top, including transcord breaker.** |
| **Center to center distance** | **947 feet.** |
| **Total lift** | **272 feet.** |
| **Incline** | **18°33′, or a 35.53 per cent grade.** |
| **Belt speed** | **578 fpm, wet or dry.** |
| **Handles** | **550 tons per hour of iron ore. (Average size 5 in. Some pieces up to 10 in. × 5 in. × 8 in.)** |
| **Drive** | **V-flat lagged snub drive with 257° arc of contact on 49 in. head pulley and 36 in. snub pulley. Tail pulley is 42 in.** |

Belt users are generally familiar with the advance in conveyor belt design from fabric to cord, paralleling the replacement of fabric tires by cord construction tires. However, it is particularly interesting to note that it is largely because of the greatly increased cushion in a belt carcass of free floating cords that we have been able to use certain synthetics advantageously for conveyor belts handling heavy abrasive materials. This added cushion and flexibility, which was greatly responsible for the tremendous tonnage increase handled by natural rubber cord belts, compensated for the difference between buna-S and ultra-expensive synthetic compounds, and has enabled conveyor operators to maintain economical material handling costs which would have become prohibitive otherwise.

Additional cushioning of the most severe impact loads, which are those encountered in the belt loading points at the mines and where the run of mine ore is loaded onto the first conveyor belts, is accomplished by means of zero pressure pneumatic impact carrier rolls, shown in Figure 15. This design of pneumatic impact rolls uses a series of rubber tires that are hollow cored units which eliminate the objections to separate or inflatable inner tube type and maintain the same pressure and resilience without any hazard of punctures or blowouts or special maintenance. They are mounted with five rollers per shaft, and three of these sets are used under each impact loading station. These pneumatic rolls are used at all transfer points in the various belt systems. By mistake, the original "skirt board" material used was ordinary friction surface transmission belt, which, like cut sections of used fabric conveyor belting, will pick up and retain fines. This soon results in a veritable emery cloth edge that grinds through the belt cover. Before any serious damage had occurred, this was replaced by soft rubber skirt board lining which rolls away the fine abrasive particles instead of retaining them. A definite clearance is maintained between the belt and skirt by using a double taper, slightly increasing both width and the space between skirt and belt as the load goes away from the chute. This combination of the soft rubber skirting and increasing clearance in the direction of travel shown in Figure 16 practically eliminates the all too common and expensive skirt board wear. At other points in the system our own type of shock idler mountings are used.

Experience on other major conveyor installations had

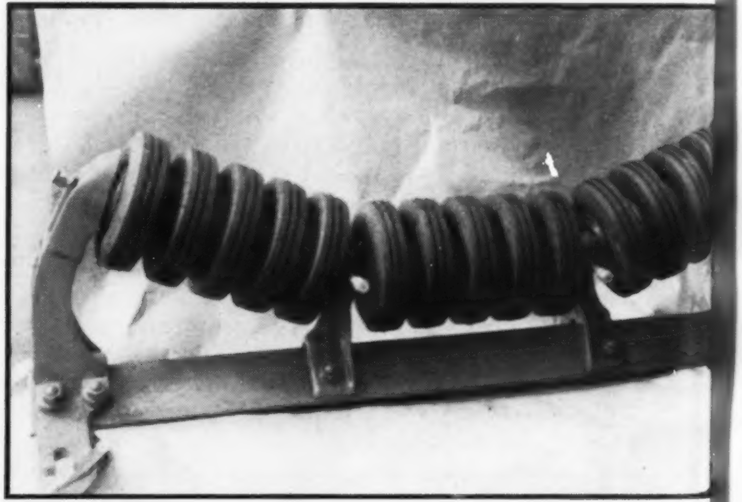
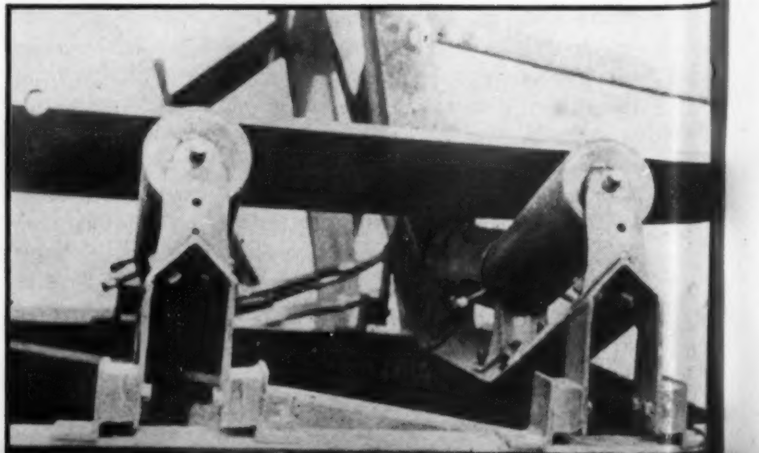


**Figure 15 — Pneumatic impact carrier rolls cushion the shock of impact loads.**

▲

**Figure 16 — Short idler mounting — another development to prolong belt life. Rubber bonded to steel with no metal to metal contact, and the idler hangs to its supports by rubber which absorbs most of the loading shocks.**



convinced the Kaiser engineers that one of the greatest safeguards to successful belt operation is to eliminate the use of metal fasteners and make vulcanized splices as shown in Figure 17 to accomplish endless belts on every unit of the system. This was the program at Fontana, where a highly experienced field vulcanizer was delegated that responsibility as well as the care and maintenance of the belts in operation. There has been no serious delay in operation due to any belt failure in that plant.

An interesting difference in belt stretch characteristics was illustrated at the time the Fontana conveyor system was installed. Fabric belts, due to weave crimp, will have considerable permanent stretch unless overbelted beyond reason. It has become common practice, therefore, to apply these at high initial tension with takeups on the extreme short side in hopes that the stretch will not be more than the allowable total takeup will absorb. In fact, unless very liberal takeups are available, operators will seldom vulcanize endless fabric belts until the initial stretch has worked out.

The stretch in cord belts is practically negligible, even when loaded to full rating, and there is a slight shrinkage in highly humid atmospheres. As a result, these belts can be vulcanized endless on any normal takeup or tension by setting the takeup at a mean position and using only the prescribed initial tension, with no hazard of having a resplicing problem in the future. In addition to avoiding overstress when first applied, having the takeup equidistant from the limit avoids bumping and unequal working tensions. The cord belts at Fontana, applied at 50 per cent takeup, are still at approximately the original position, and this includes one short belt on a 24 in. screw takeup.

A fully equipped maintenance shop with a range of portable electric belt vulcanizers was installed at Fontana and is in constant operation. It is equipped to make vulcanized splices on any size of belt up to 60 in. in width. With this equipment and the constant supervision of the trained crew, any damaged area that may occur on any belt is immediately repaired by vulcanized patches. Such thorough belt maintenance accounts in large measure for the fine success of the entire system and for the establishment of the low costs in the plant in handling materials.

It would entail entirely too much detail to attempt to outline what would be needed for complete splicing and repair service in any individual plant. The information, however, could easily be developed for a specific plant or series of plants interested in vulcanized splices and repairs of their conveyor belting. Portable presses are available to splice belts all the way up to and including 60 in., and arrangements can be made for training men of your own selection in the technique of doing this work. From the standpoint of repairs, there is nothing in the field of belt maintenance that will pay greater dividends than an ordinary vulcanized cover repair service. In some plants it is done entirely with company-owned equipment and company personnel. In other plants arrangements have been made with jobbers, who are properly equipped to come in on specific shutdown dates for this type of work.

Small, inexpensive vulcanizers for cover repairs are available for as low as $65. This machine is a round 8 in. diam platen. Repairs are made by the use of a gasket cutter with one blade removed. Cases have been known where one operator has kept as many as five of these vulcanizers busy while working his way down the belt for the full duration of the shutdown time. Splicing vulcanizers which are also used for repair work, are available for $200 for a small machine to handle 8 in. wide belts, and up to approximately $1500 for machines to handle 60 in. belts.

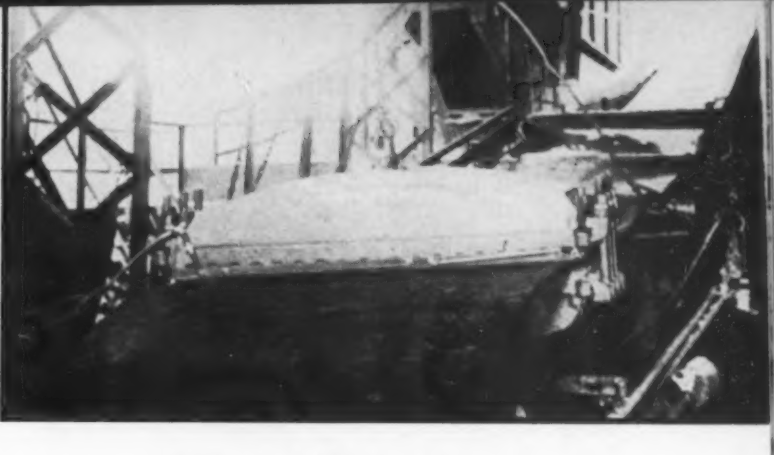


Figure 17 — Belt vulcanizer.

Large plants have found it to their economic advantage to have complete maintenance and repair shops set up and equipped so that injured belts may be taken off the installation and brought into the shop for repair. This also operates as a salvage station, and thousands of dollars worth of belting have been reclaimed by odd-time employment of these men on belts otherwise classified as useless. Some plants even go as far as to develop regular programs whereby wide, heavy belting finally ends its useful life as light, narrow belting on entirely different drives than those for which it was originally purchased.

# DISCUSSION

PRESENTED BY

**W. H. COLLISON, Superintendent Coke Plant, Blast Furnace Division, Great Lakes Steel Corporation, Ecorse, Detroit, Michigan**

**P. W. VAN ORDEN, Manager Belting and Packing, Industrial Products Sales Division, The B. F. Goodrich Company, Akron, Ohio**

**J. A. FAGNANT, Basic Industries Department, Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin**

**E. A. HAWK, Fuel Engineer, Tennessee Coal, Iron and Railroad Company, Ensley, Alabama**

**PAUL J. BOWRON, Superintendent Annealing Department, Tennessee Coal, Iron and Railroad Company, Fairfield, Alabama**

**W. F. MITCHELL, Tennessee Coal, Iron and Railroad Company, Pratt City, Alabama**

**BIRGER THELE, Electrical Engineer, Coal Mining Division, Tennessee Coal, Iron and Railroad Company, Birmingham, Alabama**

**W. H. Collison:** Approximately what is the cost and time required for vulcanizing the splice for a 42 in. belt or a 36 in. belt?

**P. W. Van Orden:** That is an indefinite figure. If all the materials can be brought to the job so the job can be started on schedule, a 42 in. or 36 in. belt of ordinary weight should be spliced in from six to eight hours. The time can be dragged out by elaborate preparations, lack of knowledge or experience. Like any other maintenance job, 90 per cent of it is preparation. The cost over a period of time will be considerably less than ordinary metal fastened belts.

**W. H. Collison:** If you have an opportunity to plan a splice of a belt, will it be tied up from six to eight hours?

**P. W. Van Orden:** Yes.

**W. H. Collison:** What type of rubber, natural, buna-S or neoprene do you think will be in the normal postwar conveyor belt?

**P. W. Van Orden:** In an equitable rubber market, we would probably go back to natural rubber in ordinary conveyor belts, with compounds similar to that used before the war. The compounds would reflect whatever improvements have been made in the art.

On hot material conveyor belts, our company will stick to the synthetic rubber that we are using today.

**J. A. Fagnant:** Have you any information on the use of castor oil dressing on conveyor belts?

**P. W. Van Orden:** Natural rubber is very much harmed, by mineral oil. There are a great number of belt dressings on the market that have as their basic ingredient mineral oils and rosin and materials of that kind. Their object is, primarily, to refreshen or make sticky the surface of a transmission belt. But, in order to avoid the building up of lumps that are usually caused by ordinary type dressings, which are difficult to put on and which gather dust, we recommend on rubber transmission belts the use of a small amount of castor oil, which softens and removes the glaze on a transmission belt that has probably been slipping. Castor oil is merely used as a belt dressing, and as a matter of fact, castor oil combined with hydrogen is the basis of a good number of belt dressings.

**E. A. Hawk:** Is the purpose of bedding the ore to which you referred in your paper, at attempt to obtain uniformity?

**P. W. Van Orden:** It is to give uniformity to the feed. With the different types of ores at the plant, the best way to bed them satisfactorily into the mixture they wished to use was to stock them in about the same ways as a woman would make a layer cake and then start cutting off the end. The thicknesses of the layers put down were known and by taking a slice off the end, the mixture going into the furnace was known.

**Paul J. Bowron:** In connection with the bedding and handling of the ore at the blast furnaces, was it the thought of the engineers that the method would be more economical than the use of ore bridges as is seen in the north? Does the method accomplish the same general end of mixing and stock piling the ores as is obtained with the ore bridge?

**P. W. Van Orden:** I cannot answer that question, as I was not able to see the cost figures, and about the only answer I could give to you is that it was estimated as being more economical but I do not know whether it has actually turned out that way.

**W. F. Mitchell:** You spoke of the Mesabi belt as being the longest belt carrying a heavy tonnage up a steep grade. Is that correct?

**P. W. Van Orden:** Yes, that is their number 16 belt.

**W. F. Mitchell:** You spoke of that belt having the greatest lift of any belt known.

**P. W. Van Orden:** That was on the Mesabi range.

**W. F. Mitchell:** I notice from the pictures that the belts in these plants carry mostly fairly well graded material as far as sizing is concerned. If they have a condition such as we occasionally have in coal mines, namely, handling extremely long and thin pieces of rock, I wonder what success they have had in keeping the belt trained?

In connection with that Mesabi belt, is the ore prepared before it is placed on the belt? As it comes on the belt, it is probably uniform within limits but I am asking if they have experienced any difficulty in training that belt due to conditions I have described?

**P. W. Van Orden:** The ability of any belt to run straight is governed by its contact with the idlers. Consequently, the belt that you are going to put on the job must hit the center idlers during its training. Then, if the center idlers all the way along the line are properly lined up the belt will run straight.

If a load is put on that belt and if the load is dropped off center, there will be a tendency to make the contact greater with the side idlers and thus causing the belt to run off to one side.

On the Mesabi installation we did two things. If we can start the belt straight over the tail pulley every time, it will help a great deal. Consequently, we put guide idlers on the return side of the belt in order to get the belt straight over the tail pulley.

Then that belt and practically every belt we design is loaded through a grizzly by pan feeder. The material has been crushed, and it is loaded over a grizzly to get a bed of fines to protect the belt against anything that might come over the grizzly which might be sharp, and this ore is very sharp, since it breaks with sharp edges. That method of loading gives a maximum load. In practice, the load on that belt is practically a theoretically perfect load. The larger pieces are all riding on a heap of fines placed smack in the center of the belt. They have had absolutely no running off on that job.

We do not recommend them usually but on that job there are guide idlers standing up by the side which are unnecessary.

The reason for that job was the high maintenance cost. Having a seasonal operation on the range operations must start as early as possible and operate as late as possible. Also, in that mine there was a great deal of paint rock. Before we made this installation they had two transfer points which were running 24 hours a day, which required one man at each of the transfer points per shift requiring six men every 24 hours. They also had many chute clogs. By putting the one belt in those transfer points were eliminated with the consequent need for men at the transfer points.

The trend today is to eliminate series of conveyor belts and put in belts which are as long as we can possibly make from a tension standpoint.

**W. F. Mitchell:** On a belt of that kind, what would happen if a piece of ore three feet long got on?

**P. W. Van Orden:** It hits the crusher before it gets on the belt. Are you thinking primarily of where you load without crushing?

**W. F. Mitchell:** I am thinking of the mechanical loading practices in coal mines. Sometimes all material that is shot down at the working face is eventually loaded on the belt. We have a particularly troublesome condition sometimes when a piece of rock, say, 12 to 16 in. wide, 3 in. thick, and 3 ft long, drops on one side of the belt.

**P. W. Van Orden:** If it is not thrown back on the belt it goes down the line and knocks out the idlers and breaks the edge of the belt as it hits each idler. About the only thing you could do with that is to attempt to get the men to break the stuff finer. There is no known mechanical device that takes care of that.

**W. F. Mitchell:** Does this Mesabi range belt handle only crushed ore?

**P. W. Van Orden:** Practically everything you have up there has been crushed or shot fine enough so you do not get trouble, since it is cheaper to make some arrangement to get the material down to the right size than to let too large material get on the belt. In most of the operations on the Mesabi they move their crushers into the pits.

**Birger Thele:** Have you any comparative data on the life of belts using across the line starting compared with reduced voltage starting?

**P. W. Van Orden:** I cannot give you the figures. The reduced voltage starting is usually more effective as far as transmission is concerned. On a conveyor belt we would like to see about 20 seconds starting.

**Birger Thele:** Do you have any particular thought as to the horsepower of the drive when you ought to go to reduced voltage starting rather than across the line starting?

**P. W. Van Orden:** I would avoid across the line starting as far as possible. There are very few things in a plant that cost more than the replacement of conveyor belts year after year. Since this is the biggest cost you have, you can afford to spend a little money on control to safeguard it.

## *Edmonson* DISCUSSION

(*Continued from page 83*)

**O. J. Leone:** How does the change in viscosity affect the efficiency?

**G. V. Edmonson:** The thought that increased viscosity of fluid will increase the power transmitting capacity of a fluid coupling is expressed frequently. This is not the case. The tendency for higher unit capacity with fluid of lower viscosity can be understood when it is realized that the fluid coupling transmits power by the circulation of a weight of fluid impinging against an impulse turbine section or, in other words, release of kinetic energy. The capacity of a unit is dependent on the weight per unit volume (density) of fluid circulating per unit time, and the less viscous the fluid the more readily that fluid will circulate.

Increased capacity is possible for a certain size fluid unit by using a fluid of higher specific gravity. Oil is generally used for the reason of economy and its lubricating qualities. Other fluids have been used successfully. In our regular units, we normally recommend an oil with a viscosity of 150 SUS and 100 F. The Navy Department use 300 SUS oil for the reason that the gears of the reduction unit are lubricated in the same oil as that used for power transmission.

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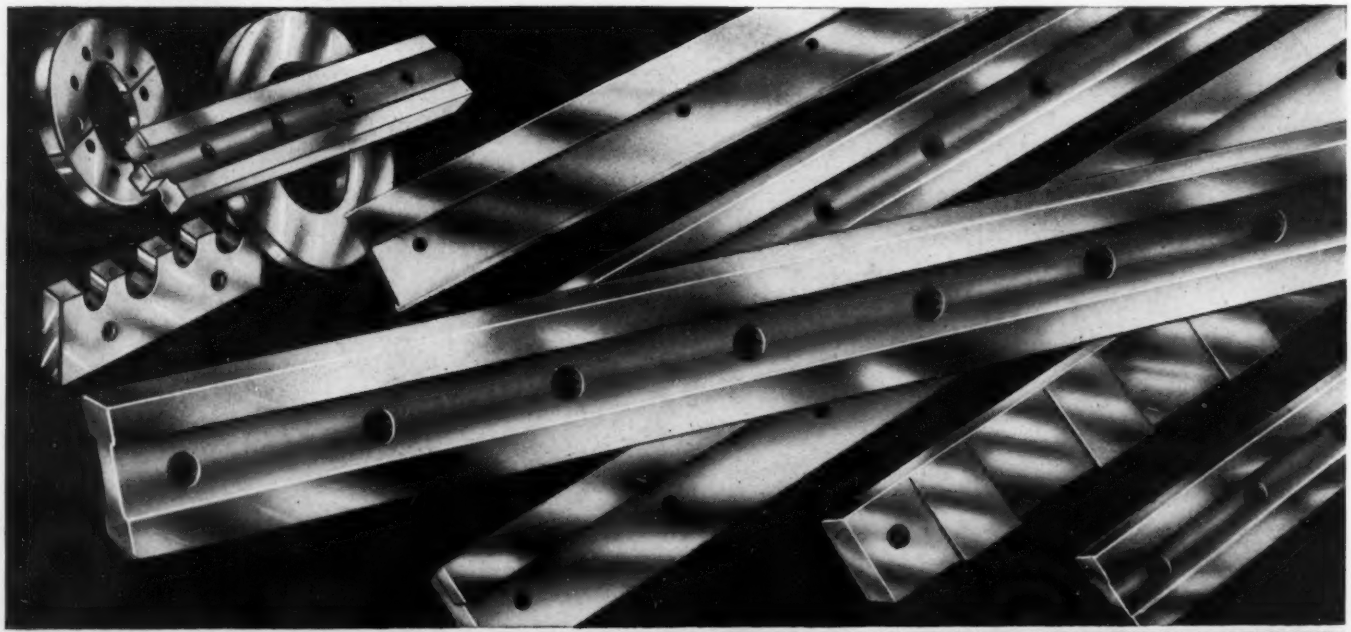

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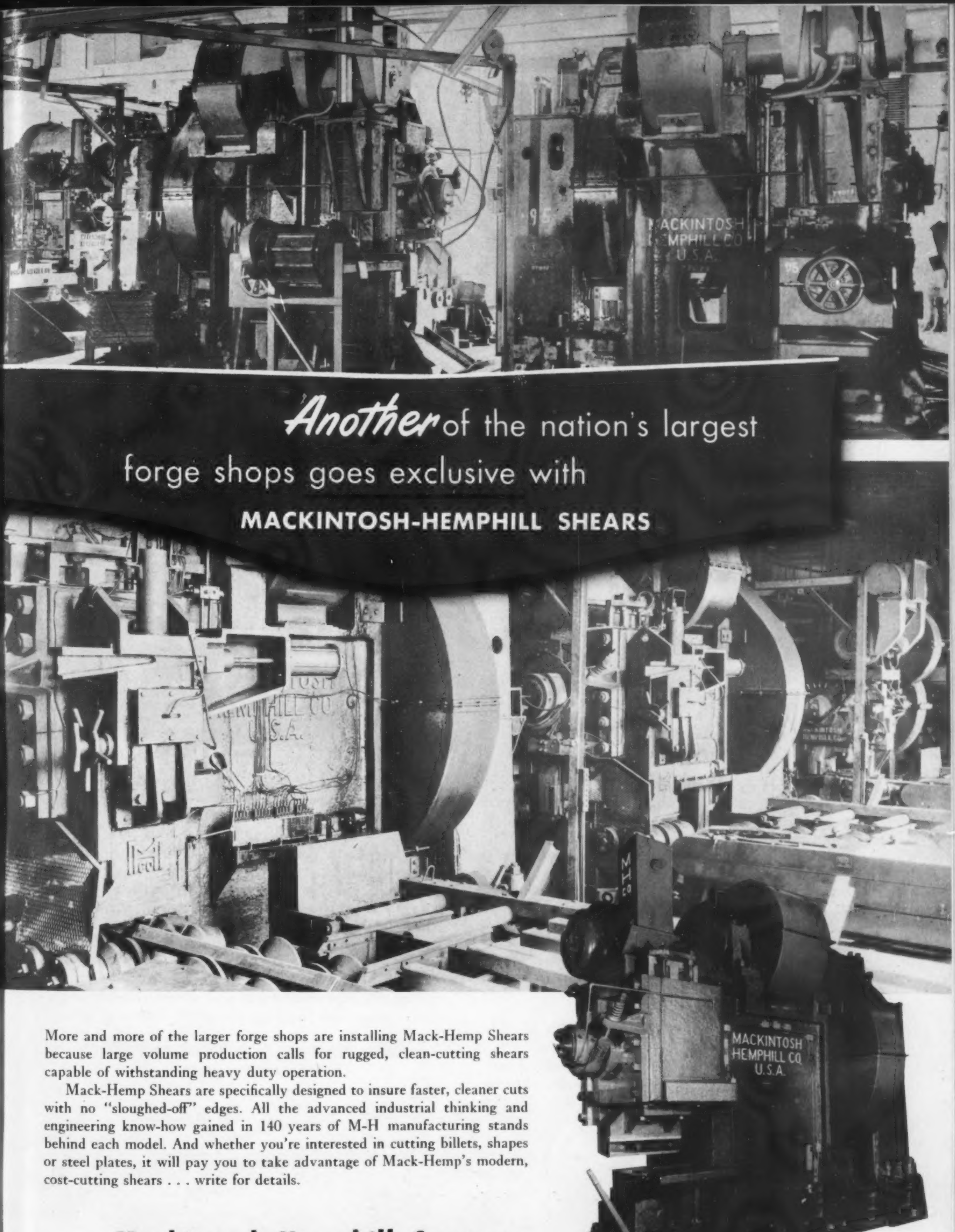

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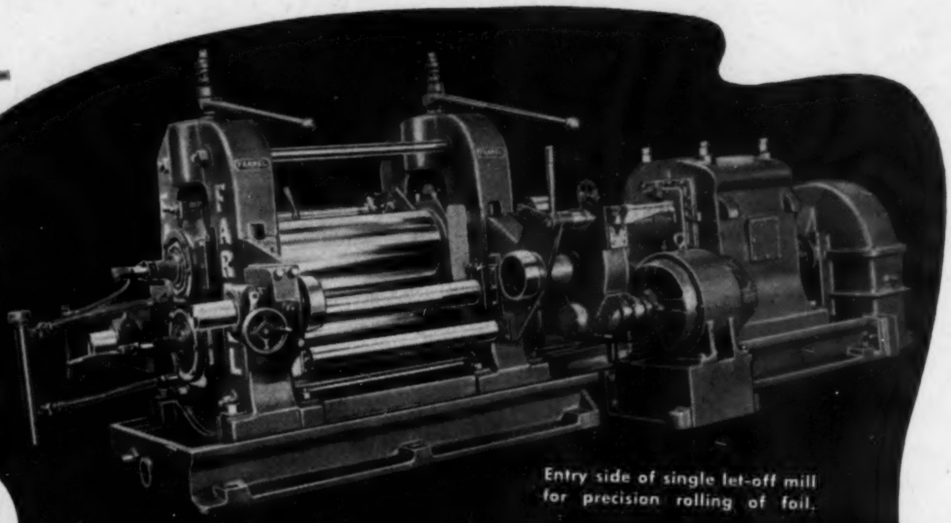
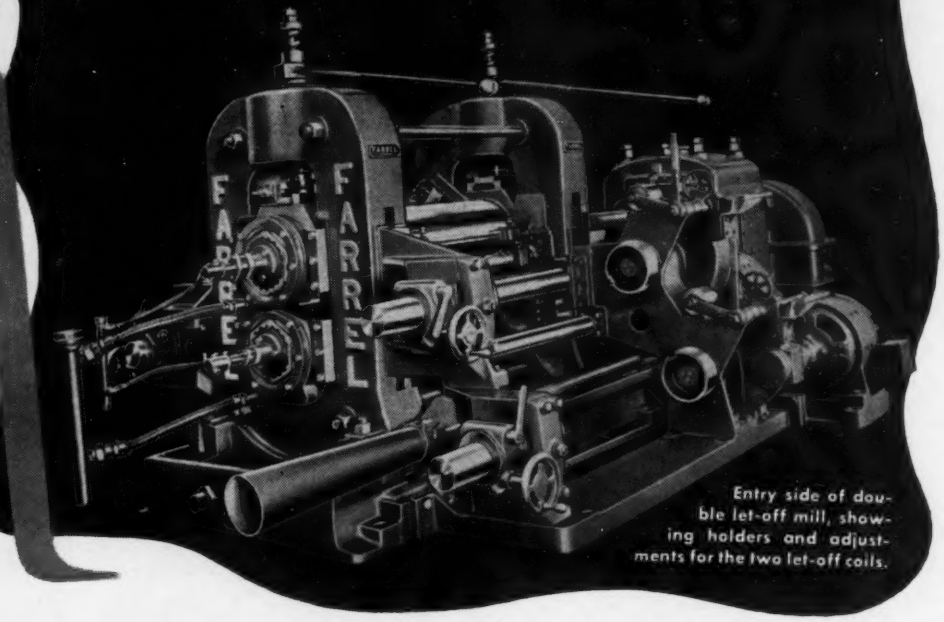


Entry side of single let-off mill for precision rolling of foil.



Entry side of double let-off mill, showing holders and adjustments for the two let-off coils.

A good example of Farrel *designed-for-the-job* equipment are these two rolling mills, part of an installation of twelve mills built especially for precision rolling of foil to finished gauges ranging from .0005" to .00025".

Mills with single let-off reduce the thickness of strip by a series of passes, each pass making about fifty per cent reduction in gauge until the foil is approximately .001". The double let-off mills then roll a doubled strip to finished gauge.

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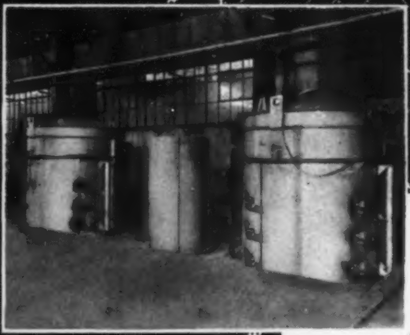

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P.I.E. bell furnaces used for annealing alloy steel coils (see inset picture) reduce heating time; are economical on fuel; cut maintenance cost of radiant tubes. These furnaces are used to anneal sheets, strip coils, wire, or castings for both carbon and alloy steels.

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# NEWS SUPPLEMENT

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## BRITISH STEEL MILL TO UNDERTAKE LARGE MODERNIZATION PROGRAM

▲ What has been described as perhaps one of the greatest industrial events in modern England, is the plan to erect, at a cost of $32,000,000 a new universal beam mill and a new steel plant on Tees-side.

When completed the scheme will greatly enhance the capacity of British structural engineering in the world's markets. At home it will reduce the cost of reconstruction in other industries and the cost of developing public utilities.

The mill will turn out very large steel "H" girders, 30 in. in width complete with 12 in. flanges, thus eliminating the fabricating cost of bolting flange plates to the older type "I" joists. Another advantage of the universal beam is that it has much greater strength than the bolted flange type for the same thickness and weight of steel.

In the construction of large steel-framed buildings the new beams will have the double advantage of increased strength and lower cost, without any sacrifice of efficiency in handling. It may even be economically possible to use them in ordinary house building.

In shipbuilding, too, they will play a very important part. By the universal method of rolling it will be possible to manufacture the "T" sections used especially by this industry.

These are only two British industries in which universal beams can be used; wherever the work of Britain's structural engineers is called for, both at home and overseas, they will fill an important need.

On Britain's steel rolling industry as a whole the new scheme will have a far-reaching effect. It will be a new and significant factor in the over-all drive for postwar efficiency now being made as the basis for a greatly increased volume of exports.

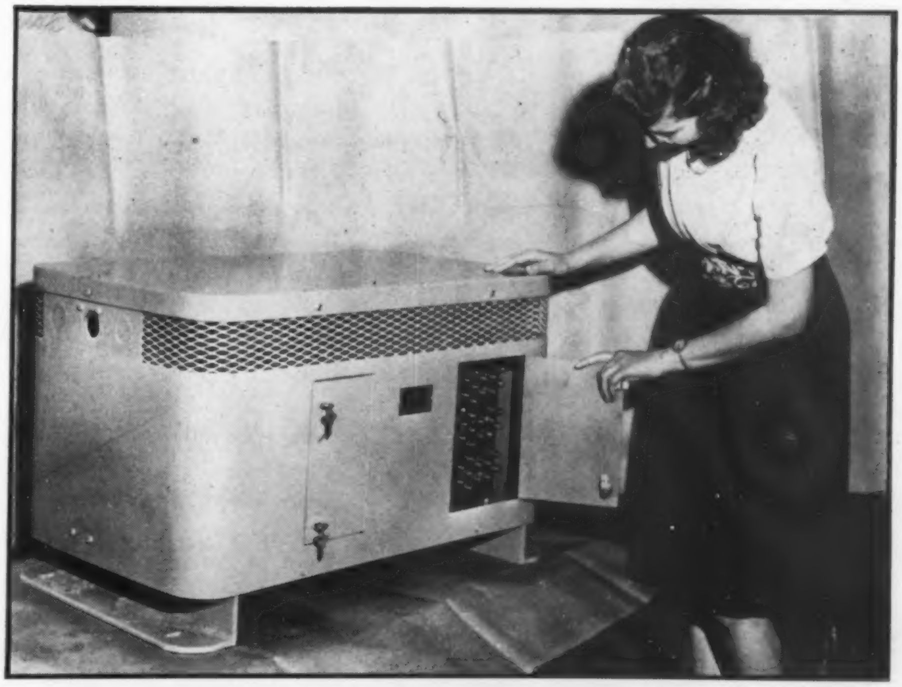
This capacity to do the work of two operations in one will be of particular importance as it will reduce the costs of production and enable this section of the British steel industry to quote competitive prices overseas.

Further economies will be achieved in the method of handling ore in the new steel plant as two separate plants will be joined and co-ordinated. A wider concentration will also be obtained, since from a single mill, will come three-quarters of Britain's output of joists. Other works will be left to concentrate on sections or billets. Since it is already known that the production of rails is to be concentrated this suggests that Britain is on the verge of all-round concentration.

The development has a double significance. Locally (in the Middlesbrough and Cleveland district) it will be regarded with great satisfaction as an assurance of continued industrial progress. Nationally it demonstrates the determination of the British steel industry to continue vigorously the policy of re-equipment begun before World War II.

The firm concerned, Dorman Long

## TRANSFORMERS DESIGNED FOR INDUCTION HEATING



**Among the many new kinds of transformers for which there was no need before the war is one for electronic heating. The requirements are for good appearance, light weight, and high secondary voltages. To accommodate these Westinghouse has developed a new family of units in sizes between 2 and 50 kva single phase and 2 and 100 kva three phase. They are air cooled and follow the experience gained with dry-type distribution transformers. They can be insulated for test voltages as high as 20,000 volts, which is nearly double the maximum of previous air-cooled transformers. Space in high-frequency generator sets is limited; hence compactness is a must. One representative unit using type C Hipersil core, high-temperature insulation, and air-blast cooling weighed 275 pounds. Had the unit been built with class A insulation and self-cooled, the weight would have been 1600 pounds and nearly as large as the entire high-frequency set.**

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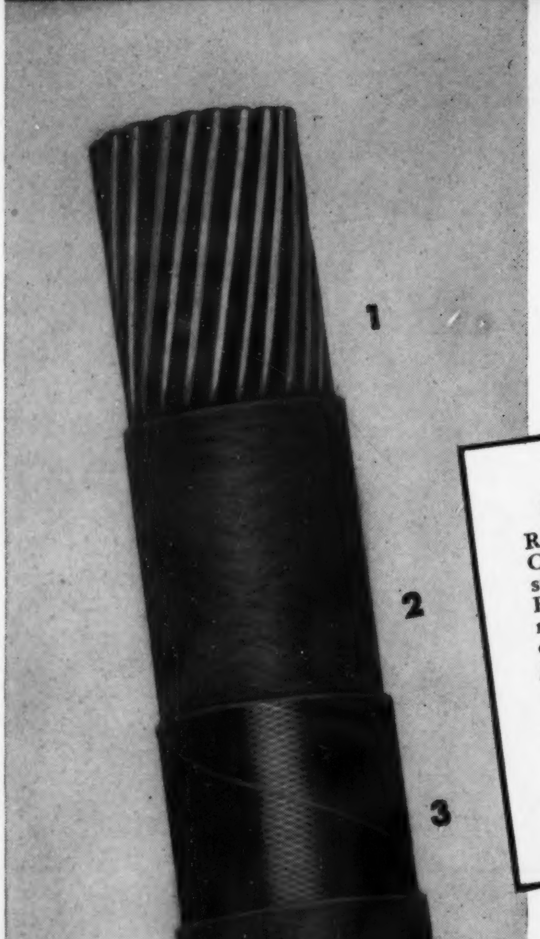

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1. The conductor is perfectly and permanently centered in helically applied insulation.
2. Felted asbestos insulation, impregnated with heat, flame and moisture resisting compounds, will withstand conductor-heating overloads and won't bake brittle or burn.
3. Lubricated varnished cambric for high dielectric strength and added moisture resistance.
4. Impregnated asbestos insulation that won't dry out, crack, flow, rot or burn.
5. An impregnated asbestos braid, resistant to heat, flame, moisture, oil, grease and corrosive fumes.

*One of 125 constructions developed for severe operating conditions by Rockbestos.*

Plan now to avoid trouble later in power, control and lighting circuits exposed to high temperatures, corrosive fumes or other severe conditions. Insure against premature wire-failure and costly rewiring by installing *permanently insulated* Rockbestos A.V.C.

These heat and flame resistant wires and cables have an *impregnated asbestos insulation* that takes the withering heat of 230°F., without baking brittle, cracking or flowing. It won't rot or swell under exposure to sulphurous corrosive fumes, oil or grease. It won't burn. And it gives you greater current carrying capacity.

There's a complete line of 125 *permanently insulated* Rockbestos wires, cables and cords — including everything from magnet wire to single and multi-conductor power cables in circular mil sizes — National Electrical Code Types — and All-Asbestos constructions. Write for a catalog, samples and recommendations.

**ROCKBESTOS PRODUCTS CORPORATION**
**125 Nicoll St., New Haven 4, Conn.**

# ROCKBESTOS A.V.C.

***The Wire with Permanent Insulation***

NEW YORK BUFFALO CLEVELAND CHICAGO PITTSBURGH ST. LOUIS
LOS ANGELES SAN FRANCISCO SEATTLE PORTLAND, ORE.

and Company, Ltd., is internationally known. Its action in announcing the new venture so soon after Mr. Morrison's statement on nationalization of the industry in Britain's House of Commons, is proof of the determination of British industry to keep up to date during the transition period. It is a good augury of success in the task ahead of rebuilding Britain's overseas trade and developing new markets.

The new process may even cause a revision of British building standards in order to give full scope to the new beams in this direction.

## ARMCO ROLLS UP NEW PRODUCTION RECORDS

▲ The Middletown plant of The American Rolling Mill Company smashed production records during the month of January while most other steel plants in the country were strike-bound. Despite adverse weather conditions and the uncertainties of the impending strike, workers in the open hearth department produced a larger output of steel ingots than in any similar period in the plant's history. The new record exceeded by 800 tons the previous peak. Not to be outdone, the cold strip mills of the Armco plant also broke all existing records for steel rolled in any previous month. New records were also established by several pickling, temper rolling and shearing units.

Reports of new production records came also from other Armco plants in Hamilton and Zanesville, Ohio, and Butler, Pennsylvania. In none of these plants was production stopped by the strike. Workers in these plants are represented by independent collective bargaining agents. Although demands for increased wages were presented, employees elected to continue working while wage negotiations with the Armco management were under way.

## OKONITE MOVES CLEVELAND OFFICE

▲ The Okonite Company, Passaic, New Jersey, announced that on March 1 its district office in Cleveland, Ohio, moved to a new location. It was formerly in the Cleveland Railroad Building, and is now located in Room 625, Engineers Building, Cleveland 14. F. J. Dahleiden will continue in charge of the office which he has managed since its establishment in 1939.

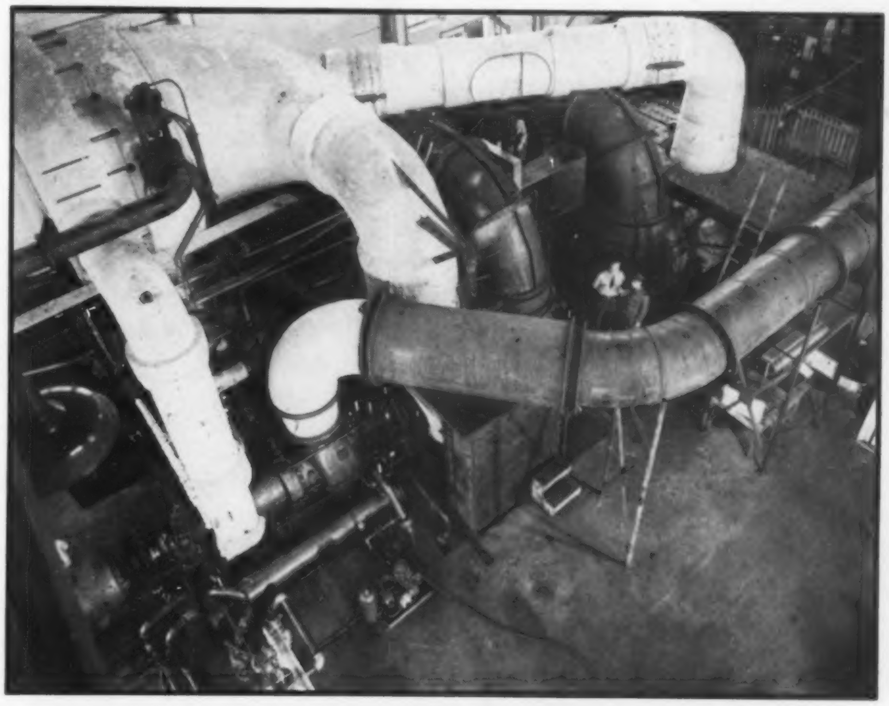
## HIGHER TEMPERATURE USED IN GAS TURBO-GENERATOR

▲ Successful operation at a gas temperature of 1350 F has been accomplished in a series of successively increasing temperature tests on an Allis-Chalmers experimental gas turbine plant installed in the U. S. Naval Engineering Experiment Station at Annapolis. Designed and built by Allis-Chalmers for eventual operation with hot gas at a temperature of 1500 F, the 3500 hp unit is the first large multi-stage gas turbine for continuous power generation at high efficiency ever operated successfully at such high temperature.

Although this highly significant gas turbine has been developed as a Navy project, its basic elements have characteristics suitable for both land and marine practice, according to Allis-Chalmers engineers.

The gas turbine plant is arranged with two turbines operating in parallel, one turbine supplying the power required to drive the compressor, the second turbine furnishing the power necessary to satisfy the requirements of the driven machine or dynamometer. The compressor unit operates at a speed commensurate with the lowest possible fuel consumption. Fresh air enters the compressor at 40,000 cfm and is discharged at a pressure of 45 psi to the heat exchanger where it picks up heat from the turbine exhaust gases. The heated air then passes through two separately oil fired combustion chambers where it is further heated to the desired turbine inlet temperatures. The gases then expand in two multi-stage turbines, one of which supplies the power to drive the compressor, the other furnishing external shaft power.

Careful to point out the experimental nature of the Annapolis gas turbine, Allis-Chalmers nevertheless indicates in its references to this major development project that it foresees a promising future for gas turbines, particularly in railroad locomotives, aircraft propulsion units, marine and electric power generation prime movers.



**Installation of experimental gas turbine plant in the U. S. Naval Engineering Experimental Station at Annapolis.**

## ELECTRICAL COMPANY CHANGES NAME

▲ On February 1, 1946 The Ideal Commutator Dresser Company changed to a corporation to be known as Ideal Industries, Inc., and as of that same date, the partnership was terminated. There has been no change in management, personnel, location, manufacturing, and method of distribution of products.

LOW-COST PALLETIZED HANDLING
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Today's indispensable team-mate of mass production is mass handling of materials, finished products and goods in process. And many producers and transporters are finding the answer in the pallet load system, handled by flexible, cost-saving electric trucks, powered with Philco high capacity batteries. One of the greatest new contributions to this system is the battery with 30% longer life—Philco "Thirty". Yes—you can specify Philco "Thirty" in your new electric trucks as well as for replacements. Get the facts today. PHILCO CORPORATION, Storage Battery Division, Trenton 7, New Jersey.

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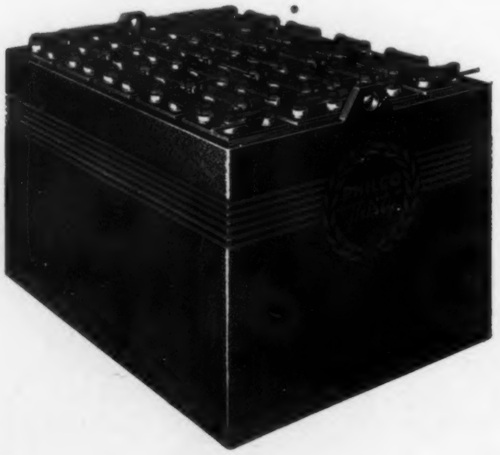


## OXYGEN RECORDER INSURES REGULATION

▲ A new automatic continuous analyzer for indicating and recording the oxygen content of a gaseous mixture has been developed by Bailey Meter Company, Cleveland 10, Ohio. This instrument has been successfully applied to boiler furnaces, kilns, many types of metallurgical furnaces, glass tanks, chemical and petroleum processes.

The instrument provides a graphic analysis almost instantly, and is said to be responsive to changes of 0.05 per cent oxygen. Sustained accuracy is said to be within 0.25 per cent.

A continuous gas sample is mixed with a vaporized liquid fuel and burned on a catalyst-filament which reaches a temperature proportional to the oxygen content. The filament resistance is a function of temperature and a simple resistance bridge is connected to a null balance electronic recorder which may be calibrated in excess air, per cent oxygen, or other desired terms.

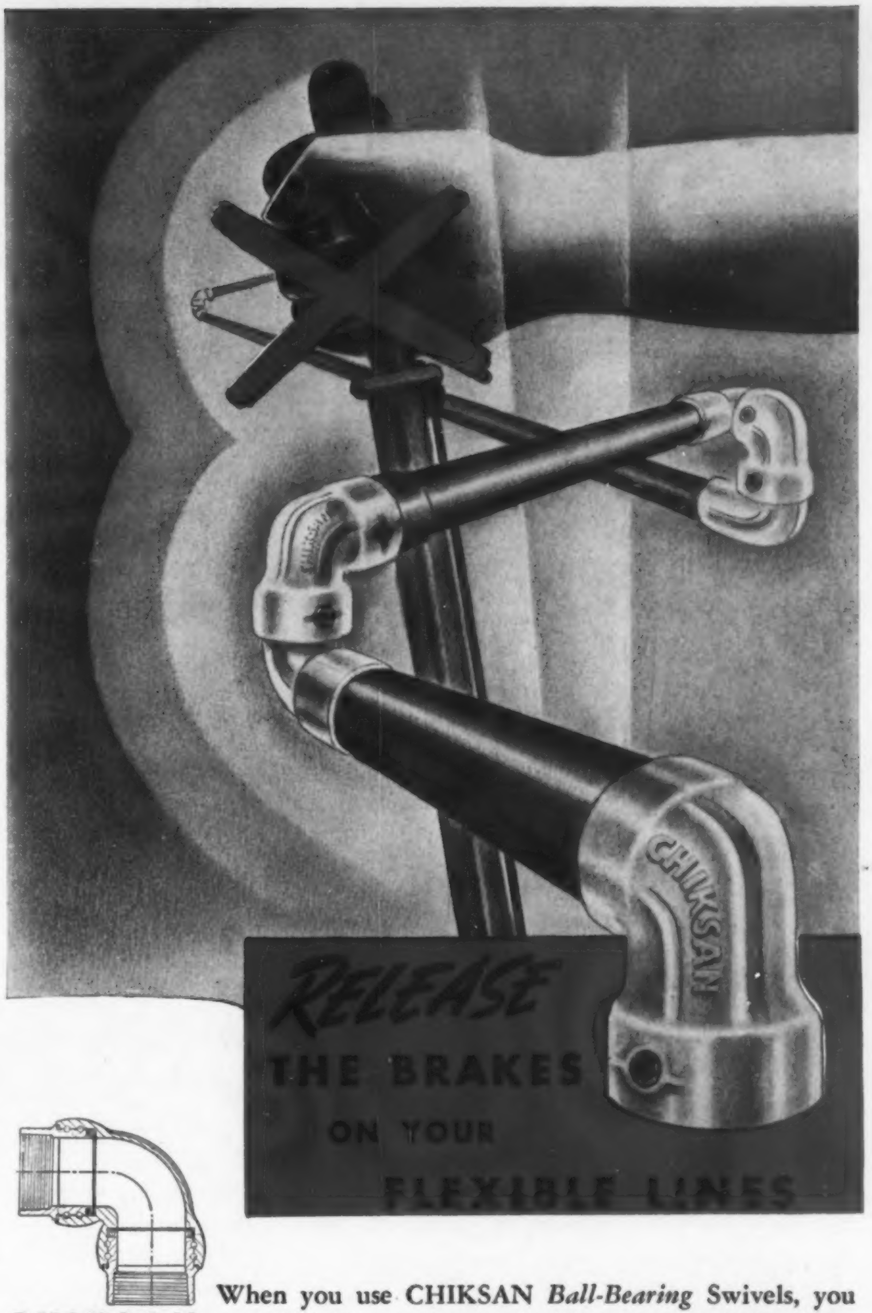
A high speed sampling system for handling dirty, high temperature gases is furnished with the instrument when required.

Oxygen recorders applied to all types of furnaces operating with oxidizing atmospheres permit closer regulation of fuel-air ratios, especially where multiple fuels are used, or where the firing rate changes rapidly. This results in not only greatly increased economy but also in decreased furnace maintenance. With process furnaces, it insures greater uniformity and higher quality of product.

## AISI ADDS TO SIMPLIFICATION WORK

▲ A technical committee of the American Iron and Steel Institute is sponsoring two closely related simplification programs which are being developed through the established procedure of the Division of Simplified Practice, National Bureau of Standards.

One program proposes a list of stock sizes and types for wire nails and staples. The other is a proposed revision of Simplified Practice Recommendation R9-28, Woven Wire Fencing.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When you use CHIKSAN *Ball-Bearing* Swivels, you get full 360° turning on double rows of ball bearings. Exceptionally low torque eliminates all strains and stresses on pipe, fittings and connections. Chiksan Swivels retain their flexibility because there is nothing to tighten or adjust... no packing glands or stuffing boxes to require periodical tightening... no possibility of squeezing the packing so hard the joint won't turn. CHIKSAN *Ball-Bearing* Swivels are supplied in over 500 different Types, Styles and Sizes for rotation in 1, 2 and 3 planes... and for every purpose.

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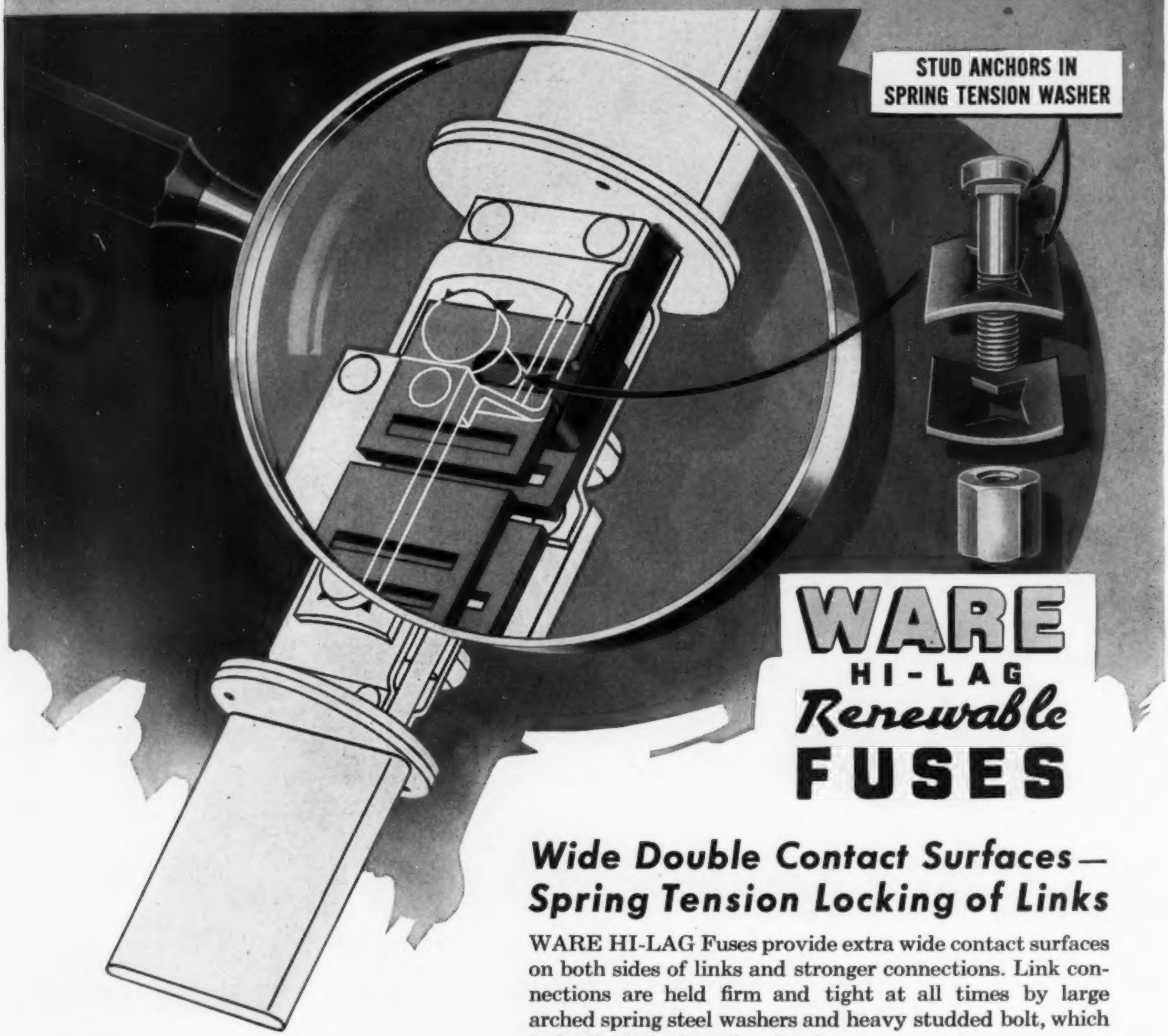
LOOK TO THE FUSE LEADER FOR PRODUCTION PROGRESS


STUD ANCHORS IN SPRING TENSION WASHER
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HI-LAG
Renewable
FUSES

**Wide Double Contact Surfaces—Spring Tension Locking of Links**

WARE HI-LAG Fuses provide extra wide contact surfaces on both sides of links and stronger connections. Link connections are held firm and tight at all times by large arched spring steel washers and heavy studded bolt, which locks the links into the circuit.

Expansion and contraction of metals during *Off* and *On* periods compress links. This fluctuation causes loose contacts and oxidization in other fuses, which finally result in excessive heating and unnecessary blows. WARE HI-LAG construction keeps contacts permanently tight, thus insuring low resistance and longer fuse life.

WARE HI-LAG has many exclusive features in addition to the above; including the Link Design-Double Bridge Knife-Blade Assembly-Gas Vents and Simplified Construction, only 3 Parts. That is why it is known as the World's Best and Coolest Operating Fuse made.

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70 to 600 AMPS.

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600 VOLTS
3 to 60 AMPS.

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# HIGH VELOCITY CONTOUR SAWING

## POSSIBLE AT RATES OF 10,000 FPM

▲ Production engineers, to whom belongs a great deal of the credit for hastening the day of complete victory, agree that no material cutting procedure has done more to speed the war effort than the contour sawing process. The term contour sawing of course refers to the use of narrow width precision saw bands in connection with specialized equipment of related type, whereby cuts are executed at an exceptionally high rate with the advantage of maximum material economy.

Due to other factors, such as ease of operation, minimum operating cost and as a substitute for various basic machining methods where chips represent cash and must be accounted for, contour sawing proved a valuable asset to help accelerate war production. The fact remains, however, regardless of a steadily increasing level of productivity for this process, the outstanding spurt dates back slightly more than a year ago with the development of the DoAll high speed contour sawing machine.

The introduction of high and super high velocities into the contour sawing picture not only stimulated this already efficient technique, but has revolutionized band saw practice as a whole.

Realizing the rapid development of a host of new materials within the past few years, we cannot escape the fact that such and their derivatives constitute a wide range of characteristics. Being either hard, soft, sticky, spongy or of an abrasive nature, each and every material invites a distinct cutting problem and therefore the various characteristics cannot be entirely overcome with the conventional speed range and saw bands of standard pitch construction.

It is obvious that the machine intended to cut or shape externally and internally some 100 basic materials, demands extreme versatility as well as precision saws of special design to supplement standard pitch saws if the equipment is to be 100 per cent efficient.

With its variable speed range of from 1500 to 10,000 fpm, ample throat and height capacity, plus the timely development of the buttress type saw, the high speed contour sawing machine meets all these stringent requirements and for this reason constitutes an all-purpose band saw adapted to all lines of manufacturing.

Most significant is that high and super high velocities open a new era for friction cutting by the band saw method. Until now it has been more or less a "sawing" operation even with sparks flying, with the saw band traveling up to and including two miles per minute the metal in the kerf now really softens to a plastic state and is readily carried away by the saw teeth.

It can be truly said that, exclusive of steels and their alloys, there is no material that cannot be cut in the high speed band saw to its full 20 in. thickness cutting range; this includes any kind of material from a stack of newspapers and a cake of dry ice to an aluminum or magnesium casting, pouring nails and all.

Insofar as friction cutting is concerned, the band saw has its limitations for the present time at least with a ½ in. to ⅝ in. thickness as a maximum and in line with practicability and economy. Standard pitch saws, 10 to 18 pitch and ½ in. to 1 in. wide are used for friction cutting, cutting rates of 60 linear inches per minute on some of the ¼ in. thick steels or armor plate are not unusual.

Recent production cutting rates, such as 192 square inches on a 4 in. thick magnesium alloy, 600 square inches per minute on birchwood, 100 linear inches per minute on ⅝ in. plastic glass and 50 linear inches per minute on ½ in. specially heat treated steel, should not be regarded as a permanent ceiling.

Judging from what has been accomplished in recent years to raise band sawing efficiency to its present level, only the surface has apparently been scratched. It is assumed that the present 10,000 fpm maximum velocity is based on the fact that higher velocities for the time being have no

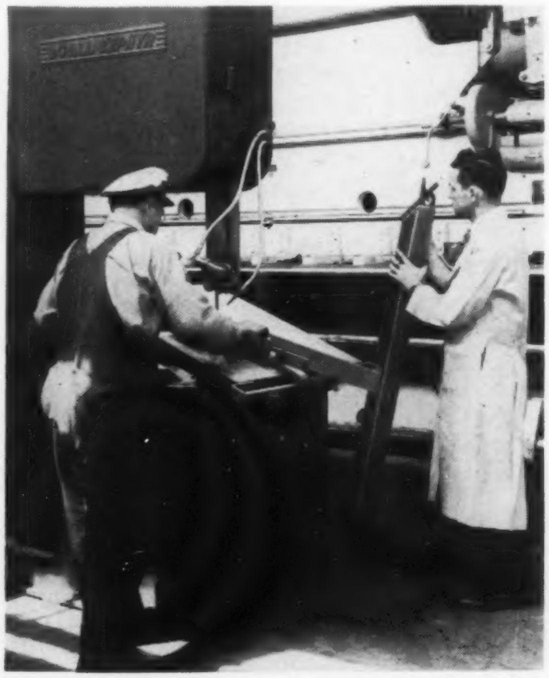

**Figure 1** — The high speed band saw is adapted to producing angular cuts of varying degrees by means of automatically adjustable table tilt, as the work progresses through the saw.

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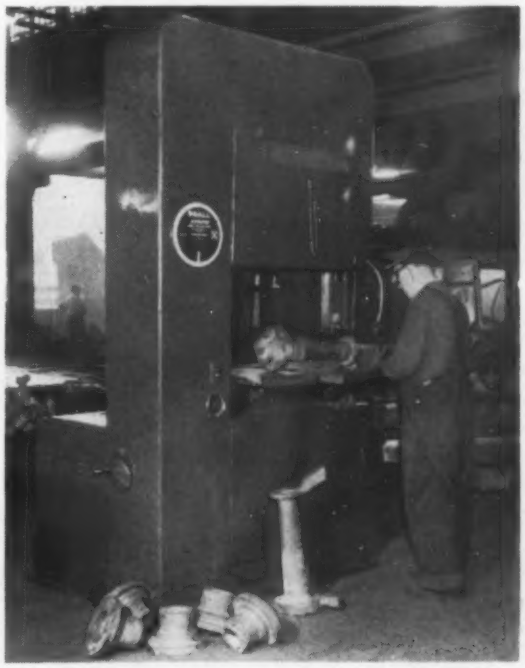


**Figure 2** — Removing gates and risers from aluminum alloy castings with ½ in. 3-pitch buttress saw operating at 3000 fpm. New type saw at double conventional velocities results in as much as three times former cutting rate.

→

extra value, and the now existing range of velocities should serve for many of the materials now in the course of development for postwar use.

However, research along these lines continues uninterrupted and is not likely to stop for a long time. There will eventually be better and better saw bands and higher and higher velocities. Who knows but what in the not-too-distant future we may friction cut 12 in. chromium steel, or actually saw it as fast as we slice through a stack of paper today?

## STEAM TURBINES BUILT IN STANDARDIZED LINE

▲ The first "standardized" steam turbine built for electric power generation is in production at the South Philadelphia plant of the Westinghouse Electric Corporation. The unit is the result of a long-felt need to remove the "custom-made" label from such machines and introduce certain standard sizes and operating conditions.

The project is a 30,000 kilowatt machine for the Riverview plant of the Southwest Public Service Company at Borger, Texas.

Steam turbines, which are the source of most of the nation's mass-production power, have themselves always been tailor made. This recent development was brought about by a committee organized by the American Institute of Electrical Engineers and the American Society of Mechanical Engineers.

The six sizes of turbines decided upon by the committee as within the range of the most common of the larger power plant sizes and therefore the most suitable for standardization, run from 11,500 to 60,000 kilowatts in productive capacity. This is sufficient range to provide power for cities from 10,000 to 50,000 population.

The committee which achieved turbine standardization, goal of both manufacturers and operators of the equipment for several years, consisted of consulting engineers, manufacturers, and owners of steam turbines supplying power to various industries and to the public.

However, the standardization program will in no way hinder production of any size of steam turbine-generator needed for purposes for which the standard specifications might not be suited.

## NEW SLAB FURNACES FOR GARY STRIP MILLS

▲ Carnegie-Illinois Steel Corporation, U. S. Steel subsidiary, has contracted for two new slab heating furnaces and the rebuilding of three existing slab heating furnaces for its Gary, Indiana works, an expansion which will give its strip mill there one of the largest capacities in the world.

The contract was awarded to Rust Furnace Company, Pittsburgh, Pennsylvania, which will make the new installations, including machinery and foundations, without interrupting mill operations.

Each of the five furnaces, both new and rebuilt, will have a capacity of 105 tons per hour. This contrasts with a rated capacity of 60 tons per hour for the three existing furnaces at present, although they were run at a considerably higher figure during the war years.

The Gary contract makes possible for the first time maximum mill production on a continuous basis. No other hot strip mill is served by more than four slab heaters.

The five unit arrangement will materially improve furnace efficiency and life, eliminating need for running at over rated capacity and producing an unsurpassed quality of heat. The furnaces will heat slabs for rolling into strips, enabling Carnegie-Illinois to meet the anticipated heavy demand for sheet steel and tin plate for hundreds of severely needed civilian commodities, from automobile bodies to tin cans. In such hot strip production, lack of sufficient furnace capacity has frequently proved a bottleneck.

The new and rebuilt furnaces have a heating rate in excess of 150 lb of steel per sq ft of effective hearth area per hour, a high capacity. They will heat slabs 3½ to 7½ in. thick; 18 to 76 in. wide; and 6 to 18 ft long.

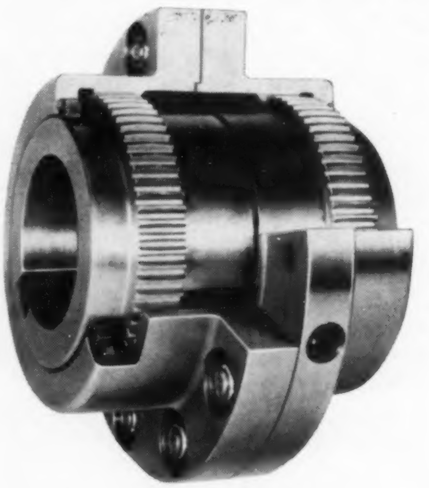
All furnaces will be Rust triple-fired, zone controlled types, automatically operated in regard to furnace temperature, pressure and combustion. All will be fired with coke oven gas.

Alloy metal type recuperators, never before used with furnaces of such size and capacity, will deliver preheated air at 700 F to the furnaces. After the recuperators, waste gas will be converted to operate steam boilers, whose capacity will be enlarged to utilize the additional heating capacity.

The very highest grade refractories adaptable to such use will be installed throughout the heating zones. Each furnace will be equipped with suspended roofs throughout. Burner and fan capacities will be increased considerably over current capacities.

## NEW COUPLINGS HAVE LARGE BORE

▲ The coupling division of John Waldron Corporation announces that a new "Series A" coupling has been designed for a much larger maximum bore to permit use of smaller sized couplings than would ordinarily be required. The smaller size coupling takes up less space, needs less shaft extension, looks better, and costs less.



It retains all the exclusive construction refinements that have always been basic in Waldron couplings; all steel, made to close manufacturing tolerances, dust proof, oil tight, identical externally geared hubs that key to shafts, enclosed by one piece male and female sleeves that function as a single rigid unit. The "Series A" coupling compensates for misalignment without adding stress to shaft or bearings.

The Waldron "Series A" couplings are made in standard, heavy duty, marine, mill motor, floating shaft, jordan, shear pin, oil collector and cut-out types.

Catalog 57 will be ready for issuance in the very near future and interested coupling buyers may obtain copies by writing to John Waldron Corporation, New Brunswick, New Jersey.

### MARKING HOLDER OUT IN WIDE RANGE OF SIZES

▲ An unusually wide range of markings is made possible with the Safety Utility Marking Outfit, newest and most versatile marking unit developed by the M. E. Cunningham Company of Pittsburgh, Pennsylvania.

The "Utility" holder is light in weight (it weighs only 10 to 12 ounces with type setup) and can be conveniently carried in coat or trouser pocket. It is especially adapted to stamping of brand names, lot numbers and serial numbers on etched plates, keys, silverware, tools, checks, tags, machine parts and for stamping stock numbers on metal bars and sheets. This new holder is available in nine sizes with type recesses ranging from ½ to 1½ in. in length.

For complete data, write to M. E. Cunningham Company, 105 Carson Street, Pittsburgh 19, Pennsylvania.

### ELECTRODE PREVENTS UNDERBEAD CRACKING

▲ A new all-position mild steel electrode, called Airco No. 312, has been announced by Air Reduction Sales Company, 60 East 42nd Street, New York City 17. It was designed primarily to prevent underbead cracking in the welding of hardenable steels.

Laboratory tests and field applications indicate this electrode is satisfactory for welding; low alloy, high tensile steels, particularly in heavy sections where preheat must be used with conventional type electrodes to minimize cracking; free machining steels which normally run quite high in sulphur; cold-rolled steels where excessive porosity is normally encountered with conventional type mild steel electrodes.

For material to be vitreous-enameled after welding, this electrode makes possible production of highly satisfactory enameled surfaces without any preheat treatment prior to the enameling operation, something that is impossible with conventional mild type steel electrodes.

### SEALED RECTIFIER IMMUNE TO TEMPERATURE

▲ A newly developed selenium rectifier can be submerged in boiling water or packed in ice and still turn alternating current into direct current at an efficiency equal to that obtained under normal operating conditions, a performance never before achieved with a plate type rectifier.

The new rectifier, a product of seven years of secret research and development by engineers of the Westinghouse Electric Corporation, consists of a heavily tin plated, hermetically sealed container inside which is placed selenium suspended in oil. It has unequaled invulnerability to high and low temperatures, a quality which insures top performance in any climate from the North Pole to the Equator.

Industrial electrical control devices; transformers, resistors, vacuum tubes, rectifiers and other heat-dissipating apparatus, are usually mounted inside a metal cabinet resulting in extremely high temperatures that mitigate against good efficiencies and long life for ordinary rectifiers. This new selenium rectifier will operate with only a slight drop in current output at a total temperature higher than the boiling point of water and will last much in excess of 1000 hours.

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**KEMP OF BALTIMORE**

## REMOTE CONTROL SYSTEM OFFERS NEW FEATURES

▲ Accurate d-c positioning and indicating equipment which can be operated from any a-c or d-c line is announced by the Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin, for general industrial use wherever remote indication and control systems are employed.

This equipment, consisting of receivers and transmitters, is expected to have wide application in oil fields, steel mills, steam or hydro-electric plants, and on shipboard, according to the manufacturer. Specific uses include governor and generator field control systems for multiple synchronized diesel-electric drives, master remote control for reversing mill motors, remote Ward-Leonard control systems for multiple diesel-electric power plant mobile units, and remote indication or control over mechanical, electrical or hydraulic devices such as level, pressure and flow indicators.

Immediate receiver response without hunting or overshooting is attained over the entire operating range of the system. The receiver is a positioning unit in which the relative strength of the magnetic fields of the stator determines the position that its permanent magnet rotor will assume. Any change in this relationship of the field strength causes the rotor to turn and assume the position corresponding to the new resultant of the two fields. The receiver torque is a function of the displacement between the rotor and the magnetic axis of the receiver.

Six sizes now available range from five ounce inches to 360 pound inches approximate pullout torque, and with a small drip-type rectifier unit may be operated on alternating current.

## ERIE ROAD INSTALLS NEW ORE UNLOADER

▲ Cleveland's lake front ore handling facilities will be greatly improved with the installation at the Cleveland ore dock by the Erie Railroad of a new 17-ton Hulett unloading machine. The new Hulett was shipped from Chicago and will be in operation by the beginning of the 1946 season. It replaces four Browning electric machines of smaller capacity which were installed in 1906. The new Hulett will give the Erie a total of three at its dock. The present machines are 15-ton capacity.

In addition to its ore handling facilities on the lake front, the Erie also maintains a million-ton ore storage dock at North Randall where ore is stored for use of steel companies in Ohio and Western Pennsylvania. The Erie and predecessor companies have operated ore unloading facilities on Cleveland's lake front for well over half a century, starting in the days when the ore was unloaded by wheelbarrows and from 24 to 40 hours were required to handle one small sailing vessel.

In contrast today the Erie dock has unloaded 40,008 gross tons into 575 cars in a single day. Ore handled over the dock amounted to 908,475 tons in 1945.

## FORK TRUCKS USED WITH LADLE ATTACHMENT

▲ Time required to handle materials represents an important factor of cost in virtually all manufacturing and distributing operations. In some it is particularly high, as in transporting foods that are frozen to process and preserve them, or metals in which heat has been generated in order to work them while molten or plastic.

Fork trucks now are being used to handle ladles of molten metal in foundries by means of a simple attachment furnished recently by the Elwell-Parker Electric Company, Cleveland. This attachment is in the form of an apron which slips over the tines of the fork and is held in place with two bolts. Outer edge of the apron is cut away in semi-circular shape, according to the circumference of the ladles. Brackets are welded to upper edge of apron in alignment to conform with arms on the ladle. Attachment and method of using it are shown in accompanying illustration.

This particular fork is of the notched type for handling railroad car wheels in upright position. Trucks with this fork and attachments, therefore, are enabled to transport the ladles in wheel foundries, carry out cast wheels while still red hot, and thereafter move as many as five finished wheels on the fork at one time to storage or point of shipment.

## CHRISTY PARK WORKS TO BE REOPENED

▲ Plans to reopen Christy Park Works of the National Tube Company at McKeesport, Pennsylvania, on a limited basis have been disclosed by C. R. Cox, president of this United States Steel subsidiary.

An order for gas cylinders and a prospective contract for spheroidal pressure vessels for the distribution of protane and butane gases accounts for the plans to reopen this plant, closed down shortly after V-J Day. It is expected that the reopening initially will employ about 250 men.

Christy Park Works produced more than 27 million shells and bombs for the armed forces during the war. The bomb-spinning method originated then to speed up bomb production will be utilized for high-speed peacetime production of cylinders from seamless pipe.

## GRAVITY CONVEYORS MADE IN STANDARD LINE

▲ For the first time by any conveyor manufacturer, Lyon Metal Products, Inc., Aurora, Illinois, is marketing a completely "packaged" line of gravity roller conveyors, a brand new Lyon product, designed with traditional Lyon craftsmanship.

These conveyors have a large number of industrial uses for the handling and transportation of cartons, bales, packages, boxes, crates and a great many other types of articles and merchandise. They are presently available in the following sizes: three straight sections, all 10 ft long and in three widths, 12, 18 and 24 in.; three 90 degree curved sections, 12, 18 and 24 in. wide; two trestles 18 and 24 in. wide. Each item is a complete unit, packaged and priced per each, simplifying selling, ordering and stocking.

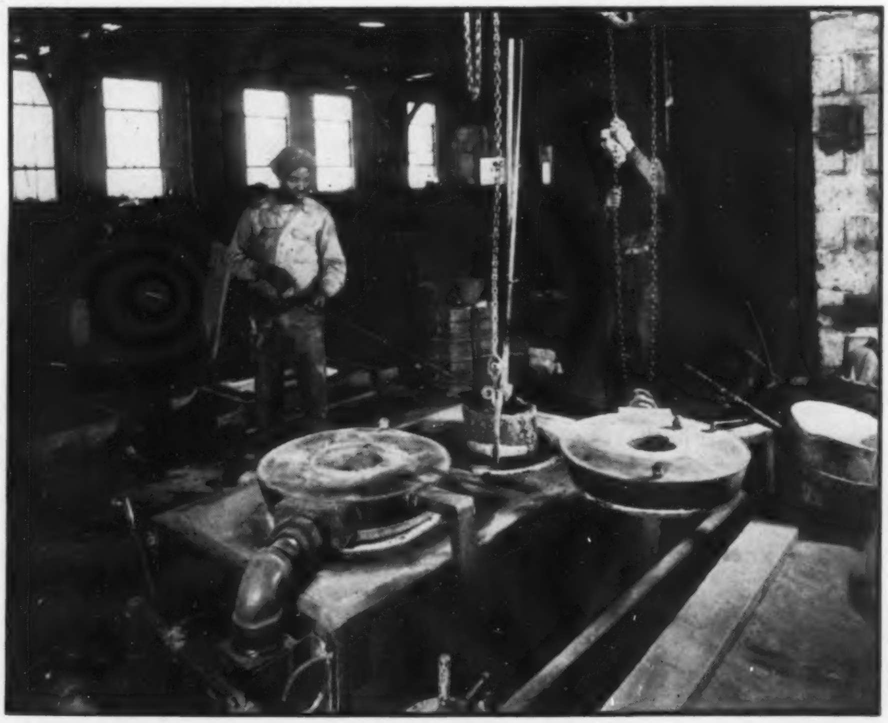
## NEW FURNACE USES TANDEM CRUCIBLES

▲ A new top fired crucible melting furnace, using two crucibles (fired with gas or oil) in tandem, is offered by Radiant Combustion Inc., of Warren, Ohio. This new furnace holds two crucibles, loaded at all times and alternately fired.

While the gas or oil flames are heating the first crucible, all of the flue gases produced are carried by a connecting flue to the second chamber to preheat the second crucible. During the pouring of the metal from the first or fired crucible, a third crucible replaces the removed crucible to receive cold metal.

The covers are cam lifted and swung backward independent of one another allowing each side to be alternately fired.

Among the advantages claimed from this new furnace, by the manufacturer are faster heating through combined radiant and convection heating; burners cannot plug because they are in the top where slag or metal cannot reach them; and far lower metal loss as the flame does not impinge on the metal. The metal is visible at all times and temperatures can be taken whenever desired without shutting off the burners. Crucibles can be had either in the stationary or tilting types.



**View of top fired tandem crucible melting furnace, showing one crucible being lowered into place while the other is being fired.**

## NATIONAL ROLL PURCHASES PLANT

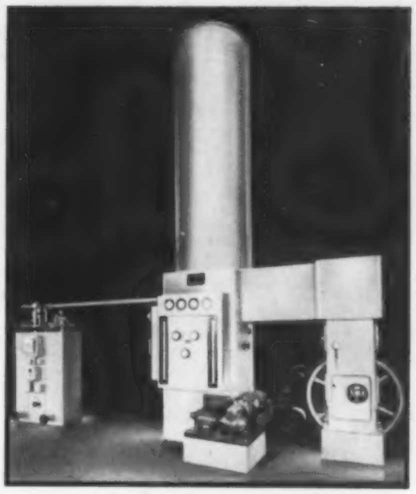
▲ Announcement has been made of the purchase of the Pottstown Pipe Products Company, Pottstown, Pennsylvania, by The National Roll and Foundry Company, Avonmore, Pennsylvania. Pottstown Pipe Products Company manufacture pipe nipples in sizes from 1/8 to 12 in., inclusive. These nipples are produced in standard and extra heavy black and galvanized steel; genuine wrought iron; seamless steel, and brass.

## OXYGEN GENERATORS AVAILABLE ON LEASE

▲ Air Products, Incorporated, Chattanooga, Tennessee, is offering a new service to industry by providing oxygen generators on a lease basis. One or more of the various-sized generators are installed within the lessee's plant, where all the oxygen produced and consumed is metered and is paid for on a volume basis.

By the elimination of high transportation, equipment, and handling costs, and by the unique features of the generators, cost economies as high as 60 per cent may be realized.

Each of these simple-to-operate, compact generators is equipped with an exclusive oxygen compressing system. Extensive use is made of Meehanite castings in order to meet the special low-temperature operating requirements of this equipment.



## WEIRTON STEEL BUYS COKE OVEN BATTERIES

▲ Construction will be started in the near future on two new batteries of coke ovens for the Weirton Steel Company, Weirton, West Virginia, by Koppers Company, Inc., Engineering and Construction Division. It is expected that the ovens will be ready for operation in about 12 months.

The contract provides for the construction of a total of 106 new Koppers-Becker underjet ovens consisting of two batteries of 53 ovens each.

To provide for additional capacity, Koppers also will make changes and additions to the present by-product, benzol and coal and coke handling plants at Weirton Steel. The new ovens are in addition to four batteries totaling 156 Koppers-Becker ovens previously built at Weirton Steel by Koppers. The amount of the contract was not announced.

## NICKEL CO. OPENS RESEARCH OFFICE

▲ The International Nickel Company of Canada, Limited announces the formation of a development and research section at 25 King Street West, Toronto, Canada. This section of the company will be staffed by Dr. Gordon S. Farnham, A. S. Tuttle and H. J. Butterill. The function of this development and research section will be to extend to Canadian industry a complete consulting and technical service on metal problems.

# New Literature

▲ "Simplified Punch and Diemaking," by James Walker and Carl C. Taylor has recently been published by the MacMillan Company, 60-5th Avenue, New York. The book consists of 235 pages, 5½ in. by 8⅜ in., and is well illustrated with 250 photographs, drawings and diagrams. It costs $5.00. Each step in the design, construction and operation of dies and punches is fully explained in the book and thus provides a comprehensive reference manual for tool engineers and others engaged in punch and die work, as well as a complete text for those who are in punch and die making. Much information on new materials and methods is included.

▲ For the first time in the safety field there will be available to management officials, safety directors, purchasing agents, insurance engineers and medical personnel, a complete safety directory and catalog, in one cover, under the title of "Best's Safety Directory and Catalog." It will give a complete, illustrated compilation of all safety, hygiene, first aid and fire protective products and devices. This vitally needed service in the field of safety, available for the first time, lists all products, equipment and devices related to safety and accident prevention; it describes fully each product in its specific category; it gives the uses of each product; it lists the manufacturer and provides a geographical list of local dealers and distributors. The catalog is not only a completely cross indexed and profusely illustrated reference of products and devices covering every phase of safety, but it gives quick answers to the questions of, what to use; in what specific hazardous situation to use it; who manufactures it and where to get it. The first annual edition will be ready in the fall of 1946. Reserve your copy now for limited printing order. $5.00 postpaid. Published by Alfred M. Best Company, Inc., 75 Fulton Street, New York 7, New York.

▲ The National Association of Fan Manufacturers has just issued a new publication entitled "Standards, Definitions, and Terms in Use by the Fan and Blower Industry." The attempt has been made to consolidate in one publication all of the standards generally recognized and accepted by the industry. For clarification, terms, definitions, and abbreviations are also included. The experience on the effect of abrasion and on field tests of fans is likewise covered for the benefit of the buying public. Copies are available without charge.

▲ The second issue of the "Bibliography of Scientific and Industrial Reports Distributed by the Office of the Publication Board" was placed on sale by the Superintendent of Documents, Government Printing Office, on February 1.

The bibliography, issued in weekly installments, contains the serial numbers, prices, and titles of reports obtainable from OPB. The reports are grouped according to subject matter. A brief summary of the contents of each report is included in the bibliography.

The price of the second issue will be 20 cents. Prices of the weekly bibliographies vary in accordance with their size, and a definite yearly subscription rate cannot yet be determined. However, the Superintendent of Documents will accept $10.00 as initial payment for the service and will notify subscribers when additional remittance is required. Copies of the bibliographies also may be purchased singly.

Orders for the bibliographies should be accompanied by check, money order, or Superintendent of Documents coupons and should be addressed to the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

▲ Another in a series of publications describing the successful commercial-scale production of good quality sponge iron in the United States has been issued by the Bureau of Mines, demonstrating that periodic brick kilns can be used advantageously without alteration, Dr. R. R. Sayers, Bureau Director, announced. Based on a recent Bureau sponge iron project at the Stark Brick Company, at Canton, Ohio, the publication reports that 468 tons of sponge iron comparable in quality to that made in the famous Swedish kilns were produced. With the exception of 42 tons retained for further Bureau testing, the entire output was consigned to various steel and wrought iron companies. Although the Canton project was concluded prematurely because of a fire which damaged considerable equipment, sufficient reliable cost information was secured to prove the feasibility of producing commercial sponge iron in periodic brick kilns, Kenneth M. Smith, ceramic engineer, and S. E. Burton, mechanical engineer, authors of the Bureau publication, reported.

A copy of the publication, Report of Investigations 3841, "Manufacture of Sponge Iron in Periodic Brick Kilns," by Kenneth M. Smith and S. E. Burton, may be obtained free by writing to the Bureau of Mines, Department of the Interior, Washington 25, D. C.

▲ A 100-page pocket-size (5×7½×⅛) handbook presenting practical information on 26 types of stainless steels has just been published by Allegheny Ludlum Steel Corporation, Brackenridge, Pennsylvania. It brings up to date, supersedes and amplifies the stainless steel chapters of the earlier "Handbook of Special Steels" and includes most of the data and information that is available on file-size "Blue Sheets" for the various types of stainless steel. The handbook contains a 44-column finder chart giving analyses, properties, hot working temperatures and heat treatment of the different types and a general discussion of types and properties of stainless. This is followed by a table of corrosion resistance of four leading types of stainless to 230 chemicals and common materials. Fabrication methods and procedures, occupying 40 pages, describe welding methods; press forming, drawing and blanking; machining techniques; spinning qualities, tools and methods; upsetting and forging; riveting, shearing, soft soldering, silver soldering, annealing and heat treating, grinding, polishing and buffing, and surface treatments, including removal of welding flux, degreasing, sandblasting, pickling, and passivating.

Stainless steel products, including plates, sheet, strip, bars, forging billets, tube stock and tubes, angles, wire, castings forgings, and clad steel (Pluramelt) are described in a 20-page section. Final pages contain general tables of bar weights, weights of sheet, weights of tubes, feet per pound of wire, decimal equivalents of fractions of an inch, and temperature conversion.

▲ A new catalog of technical books has just been issued by The Chemical

Publishing Company, Inc., 26 Court Street, Brooklyn 2, New York. This catalog includes the latest books on chemistry, physics, science, technology, medicine, foods, formularies, drugs and cosmetics, engineering, metals, technical dictionaries, building construction, etc. This catalog, conforming with the requests of technical and scientific workers and librarians, gives the date of publication of each book as well as price, number of pages, detailed descriptions and full table of contents. A copy of this catalog will be sent free to everyone who is interested in keeping up with the latest technical and scientific progress.

▲"Armco Aluminized Steel" is the title of an attractive 24-page booklet that describes one of Armco's newest special-purpose sheet steels for resistance to heat and corrosion. It is published by The American Rolling Mill Company, Middletown, Ohio. Aluminum-coated on both sides, Aluminized Steel resists destructive heat scaling up to 1500 F. It maintains a bright shiny appearance after prolonged heating up to 900 F, has good atmospheric corrosion resistance, and good radiant heat reflectivity. In addition, this new sheet possesses the strength of steel at moderately elevated temperatures and has a lower coefficient of expansion than some of the widely used nonferrous metals. The booklet is fully illustrated with charts, photographs and tables, and contains sections on heat reflectivity, mechanical properties, forming properties, painting and finishing, electrical conductivity, welding, brazing, soldering. A copy of this informative booklet may be obtained without charge by writing The American Rolling Mill Company, 939 Armco Avenue, Middletown, Ohio.

▲ Metal and Thermit Corporation, New York, New York, announces the publication of a ten page booklet on underwater cutting and welding. The booklet describes the arc-oxygen process for the cutting of steel under water and for cutting cast iron and high alloy steels in the open air and gives considerable working data and procedure information. In addition Murex electrodes for welding and for cutting light gauge materials under water are covered and instructions for their use are included.

▲ Mine Safety Appliances Company announces the production of a new demand-type oxygen mask for respiratory protection in unbreathable atmospheres. The mask is a cylinder-type oxygen breathing apparatus which features simplicity and ease of operation combined with dependability, essential requirements for efficient performance in emergency.

For a detailed bulletin describing this new M.S.A. demand-type oxygen mask or for a demonstration by a local representative write to Mine Safety Appliances Company, Braddock, Thomas and Meade Streets, Pittsburgh 8, Pennsylvania.

▲ Allied Radio Corporation, Chicago, announces the publication of a new 1946 Buying Guide, "Everything in Radio and Electronics." Special emphasis is placed on industrial maintenance, research and production requirements as well as the needs of government agencies for radio and electronic supplies.

This 1946 Buying Guide may be obtained without charge upon request from the Allied Radio Corporation, 833 West Jackson Boulevard, Chicago 7, Illinois.

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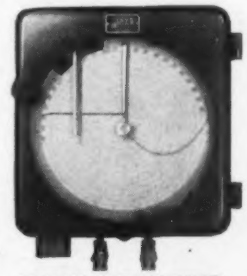
These Hays Instruments may be used in Combination or Individually.

**FURNACE PRESSURE CONTROLLER**

Equipped with external manual adjustment for automatically operating stack damper to hold pressure constant.

**PRESSURE INDICATOR**

An easy-to-read measurement of furnace pressure. Usually connected at the furnace roof.



**PRESSURE RECORDER**

A 24-hour record of furnace pressure. Shows timing of reversals and each change of pressure made by the operator during the heat.

IN up-to-the-minute open hearth plants you will find an increasing reliance on Hays Pressure Control.

Automatically this simple system regulates furnace conditions—relieves operators of many time-consuming details, gives them more time for more important duties. And Hays instrumentation can be complete or partial.

Here for a fact is "smart business." Better get the facts—write for them, or have a Hays engineer tell you about this better modern method. Representation in all principal cities of the United States and Canada.

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Heppenstall Die Blocks are naturally expected to give, *and do give,* a substantial margin of extra service. Heppenstall Co., Pittsburgh, Pa.

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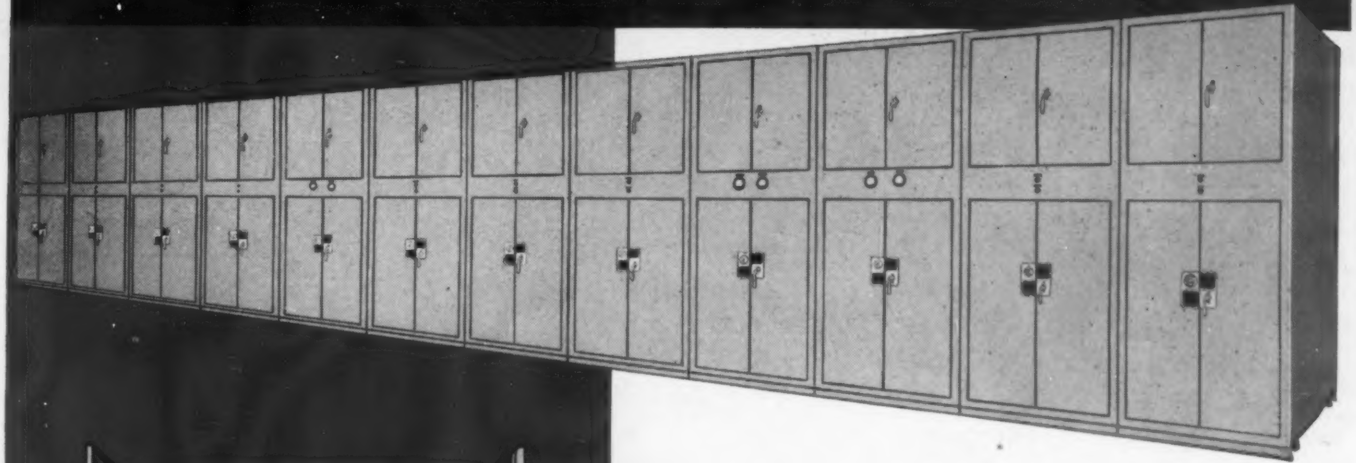
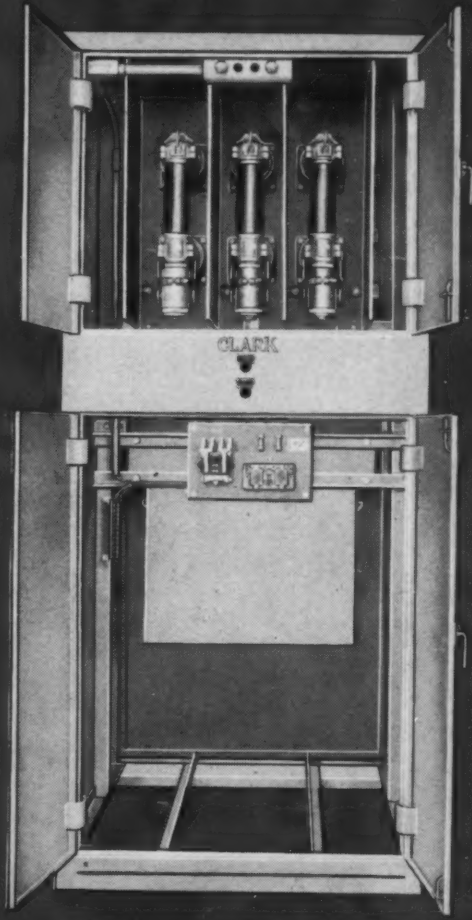
# "3C" CENTRALIZED HIGH VOLTAGE MOTOR CONTROL *saves valuable time and space*





"3C" Bulletin 6018 Type HI Motor Starter—Front View, Open. Oil tank may be lowered to inspect and service contactors.

Factory-assembled Unit Steel Cubicle construction makes it possible to install any number of "3C" Bulletin 6018 Type HI Motor Starters in a compact group. By thus centralizing control stations, valuable floor space is conserved. Installation can be made in record time because you need connect only incoming and outgoing motor leads to put the entire group of controls in operation. Additional matching cubicles can be installed at any later time, maintaining uniform, streamlined appearance.

Bulletin 6018 High Interrupting Capacity High-Voltage Starters feature heavy-duty oil-immersed contactors for safe, reliable service. Thermal overload relays give full, dependable overload protection. Equipment is available for providing cubicles with starters for use with Squirrel Cage, Synchronous and Wound-Rotor Motors.

*For complete information contact our nearest District office, or write for Bulletin 6018-HI for Squirrel Cage Motors, Bulletin 6405-HI for Synchronous Motors, and Bulletin 6100-HI for Wound Rotor Motors.*

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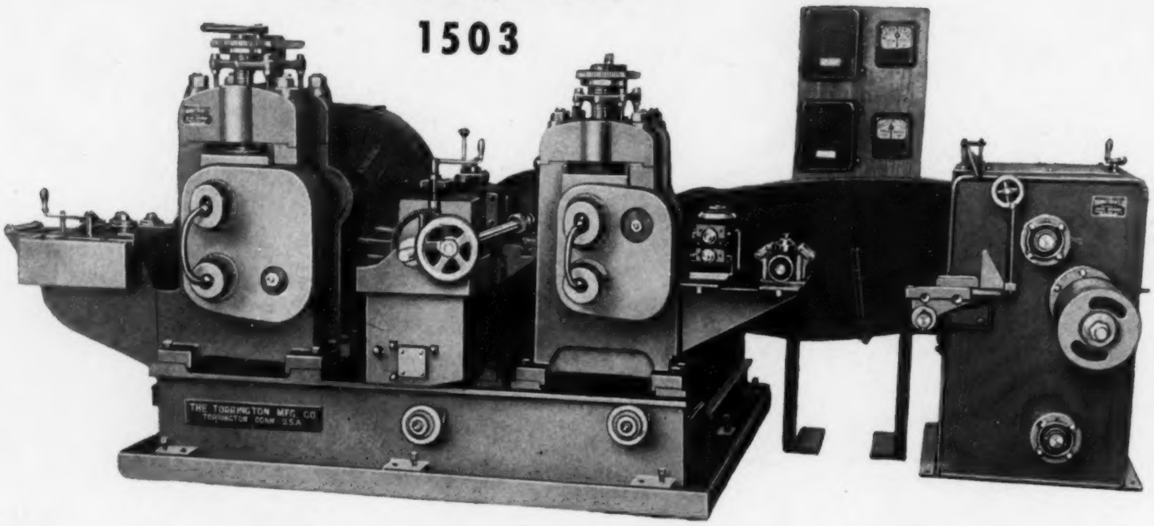
1146 EAST 152nd ST., CLEVELAND 10, OHIO • EVERYTHING UNDER CONTROL

# *Another* TORRINGTON *Special*

## FLAT WIRE MILL
## 1503



For over 60 years, Torrington Manufacturing has been designing and building special machinery for processing sheet, strip, flat wire, rods and tubes, as well as air-cooled or water-cooled molds for casting copper-bearing alloys.

Fine modern facilities include a highly trained design and engineering staff, pattern shop, forge shop, hardening room, welding shop, completely equipped machine shop, and large assembly floor covered by cranes. Experienced, skillful men work under ideal conditions.

Our standard designs can be modified to meet special requirements and we work closely with customers' engineers in adapting machines or designing and building new machines. This collaboration assures special attention to maintenance and production problems.

Privacy is guaranteed when we build from customers' drawings or design and build under their supervision. Materials and workmanship are also guaranteed.

Call or write Torrington Manufacturing with complete details of your requirements. We'll not only build a machine to suit your specifications, but will also help set it up and start it in production in your plant.

*The* **TORRINGTON**
**MANUFACTURING COMPANY**
**TORRINGTON, CONNECTICUT**

**FLAT WIRE MILLS (1503)** include five units—straightener, breakdown rolls, finishing rolls and take-up, and they convert round wire to rectangular.

### *FEATURES*

**RAPID PRODUCTION**—anti-friction bearings used wherever possible.

**ACCURACY**—rolling to thickness ± .00025" and width ± .001".

**EASY ADJUSTMENTS**—micrometer indicators give precision adjustment.

**MAGNETIC GAUGES**—for both thickness and width.

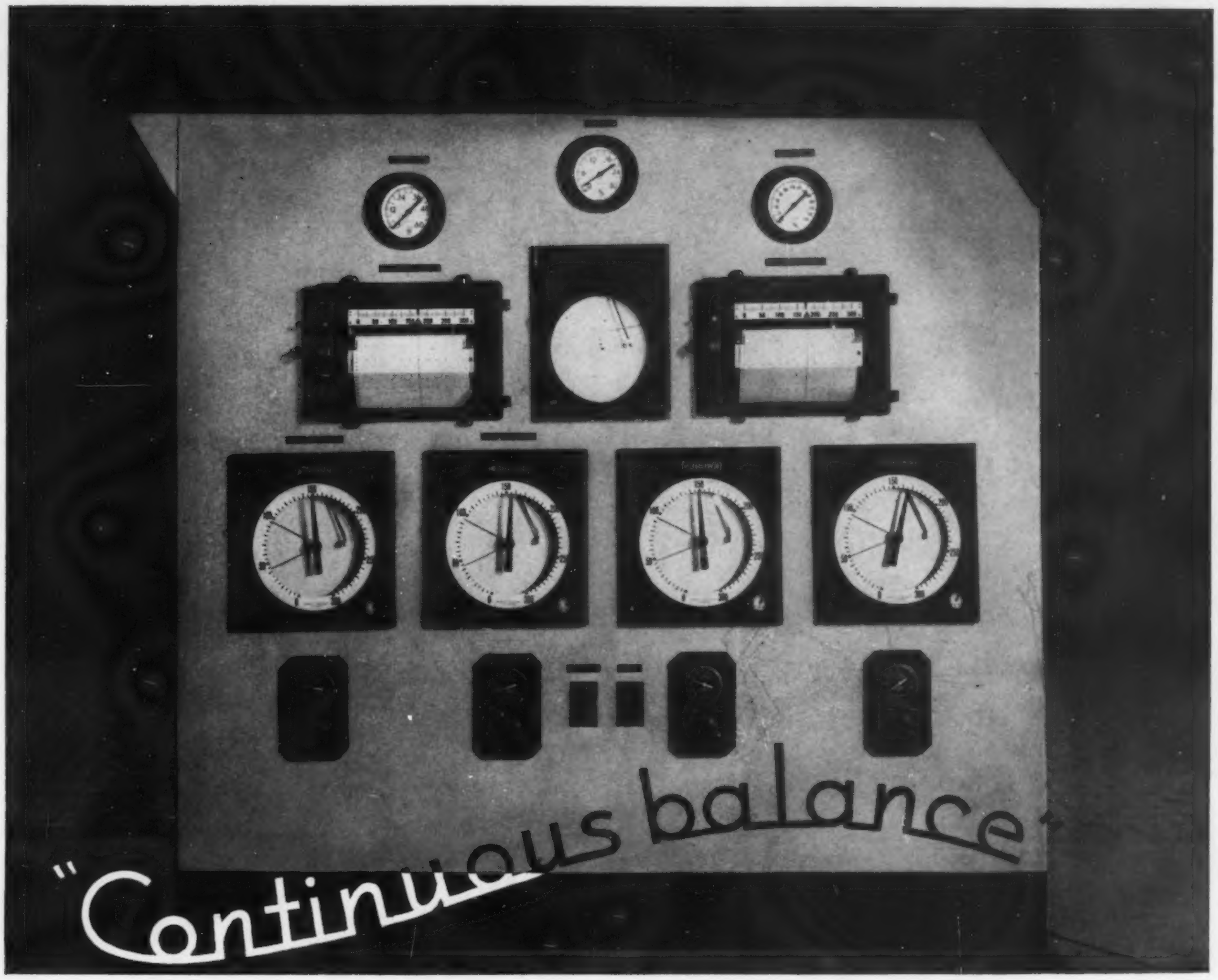
**TAKE-UP**—fully enclosed, but accessible. Arranged for scroll or traverse winding.

**INTERNAL WATER COOLING**—for breakdown and finishing rolls.

**EDGING ROLLS**—mounted on tapered arbors for greater accuracy.

**FIVE-ROLL ENTRY STRAIGHTENER**—non-driven; anti-friction bearings.

**SINGLE MOTOR DRIVE**—with drives to edging rolls, finishing rolls and take-up by slip-friction clutches, adjustable while running to compensate for elongation of the metal and spool build up.



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Brown *ElectroniK* Potentiometers—operating on the *"Continuous Balance"* principle offer the optimum in sensitivity, accuracy and speed of response. A compact electronic detecting unit provides continuous *measurement* and *control* and assures greater uniformity of product, reduced spoilage, longer furnace life, fuel savings, smoother operation and reduced maintenance costs.

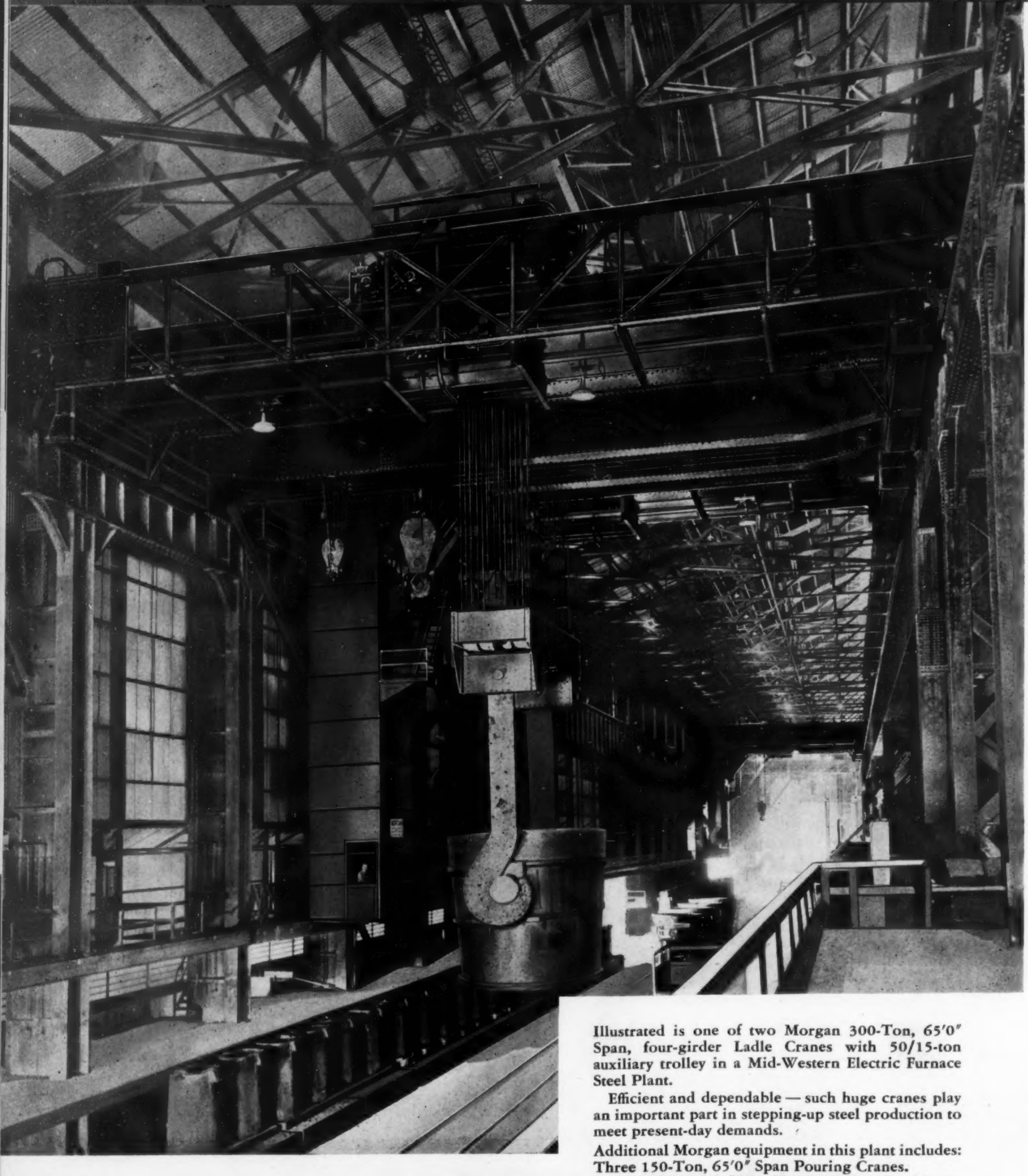
Depending on plant preference either electric or air control systems are built into the ElectroniK. Glass-enclosed mercury switches protect you from insidious corrosion failures.

Your Repair Department will be glad to know about lowered maintenance costs, too. The ElectroniK wears *only when the pointer is changing position.* Control lines, being compass circles, mean wear approaches zero levels.

You cannot afford to ignore such a tremendous advance in the art of instrumentation. Brown instrumentation engineers with their thorough field-proven experience are ready to help with your process control problems. Send for catalog. THE BROWN INSTRUMENT COMPANY, a division of Minneapolis-Honeywell Regulator Company, 4464 Wayne Avenue, Philadelphia 44, Pa. Offices in all principal cities. Toronto, Canada—London, England—Stockholm, Sweden—Amsterdam, Holland.

**BROWN ElectroniK POTENTIOMETERS**

BUILT BY MORGAN *Engineering*



Illustrated is one of two Morgan 300-Ton, 65'0" Span, four-girder Ladle Cranes with 50/15-ton auxiliary trolley in a Mid-Western Electric Furnace Steel Plant.

Efficient and dependable — such huge cranes play an important part in stepping-up steel production to meet present-day demands.

Additional Morgan equipment in this plant includes:
Three 150-Ton, 65'0" Span Pouring Cranes.
Two 150-Ton, 80'3" Span Hot Metal Charging Cranes.
Two 200-Ton, 63'0" Span Universal Type Ingot Strippers.

**MORGAN 300-TON, 65'0" SPAN POURING CRANE**

**DESIGNERS • MANUFACTURERS • CONTRACTORS** • BLOOMING [illegible] CRANES • CHARGING MACHINES • INGOT STRIPPING MACHINES SOAKING PIT CRANES • ELECTRIC WELDED FABRICATION • LADLE CRANES • STEAM HAMMERS • STEAM HYDRAULIC FORGING PRESSES
SPECIAL MACHINERY FOR STEEL MILLS

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# Personnel News

**Gwilym A. Price** has been elected president of the Westinghouse Electric Corporation, succeeding **George H. Bucher,** who has resigned from that office. Under a recent amendment of the corporation's bylaws, Mr. Price as president will be the chief executive officer.

**A. W. Robertson,** who as chairman has been the corporation's chief executive officer since 1929, has reached retirement age. He was elected chairman of the Westinghouse board of directors under the new bylaws and will continue as a member of the Westinghouse organization in a less active capacity.

Mr. Bucher was elected vice chairman of the Board of Directors and will continue to serve as chairman of the Westinghouse Electric International Company, which handles all export business of the parent company, and will have other active duties.

At the age of fifty, Mr. Price is one of the country's youngest directing heads of a major corporation. He was elected a vice president of Westinghouse in September, 1943, and had been executive vice president since May, 1945. He was elected a member of the corporation's board of directors in January, 1945.

**L. E. Osborne,** who joined Westinghouse at the age of 16 as a clerk in the tool room at the East Pittsburgh Works, recently was named senior operating vice president of the Westinghouse Electric Corporation, responsible to the president for all manufacturing units of the company. Mr. Osborne's new responsibilities also include all subsidiary manufacturing companies as well as the district manufacturing and repair department and the headquarters manufacturing division of Westinghouse. His office is transferred to the company's Pittsburgh headquarters. Throughout our nation's participation in the second world war, Mr. Osborne was the directing head of the company's steam division at South Philadelphia, Pennsylvania, and since early 1943, he was also responsible for the adjoining merchant marine division, which Westinghouse operated for the United States Maritime Commission.

**Edward E. Helm,** general sales manager of The Reliance Electric and Engineering Company, has been elected sales vice president of the company. Mr. Helm has been with Reliance since he graduated in electrochemical engineering from Pennsylvania State College in 1924. Subsequently, he managed both the Birmingham and Philadelphia sales territories, where he was particularly active in application engineering work in the steel, textile and paper industries. His appointment as general sales manager of the company was made in December 1944.

**H. A. Brassert,** chairman of the H. A. Brassert and Company, Ltd., is retiring from the English company in order to concentrate his activities in his American company in New York from where he will continue to handle their consulting and engineering business. The engineering business of H. A. Brassert and Company, Ltd., has been transferred to a new company under the name of John Miles and Partners (London), Ltd.

The new company has succeeded to the engineering business and the drawings, patents and processes of the H. A. Brassert and Company, Ltd., and is retaining the services of the staff. The new company will act as consultant on the same lines as the original company and have made arrangements with the H. A. Brassert and Company, New York, and Mr. G. Danforth, Jr., president of the Open Hearth Combustion Company, Chicago, whereby they can call on their experience when required. The directors of the new company are **John Miles,** who is chairman and managing director; **T. Thompson; A. G. E. Robiette; T. Rudkin** and **J. R. Thring,** secretary.

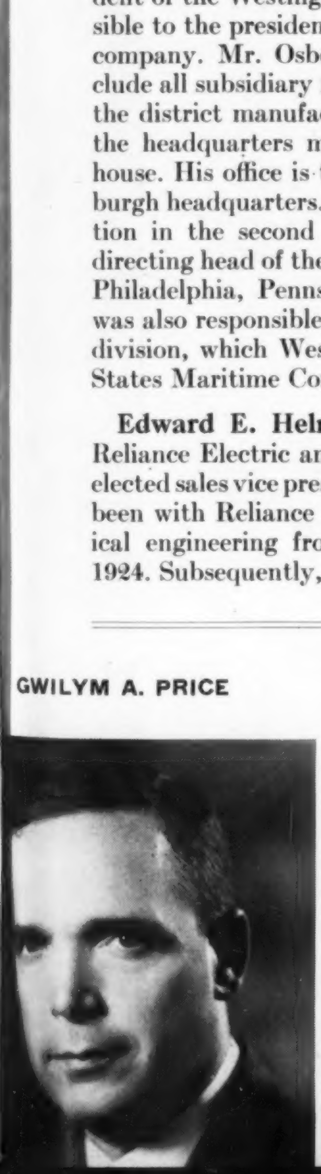
**Louis J. Reed** has been appointed assistant chief engineer of Jones and Laughlin Steel Corporation, it was announced by **C. W. Littler,** chief engineer.

Mr. Reed, a Cornell graduate, has been associated with J & L since 1926, starting as assistant chief engineer of the Aliquippa Works. In 1935 he became assistant superintendent of the tin plate department leaving that position to enter the Coast Artillery in 1943, returning recently with rank of Major.

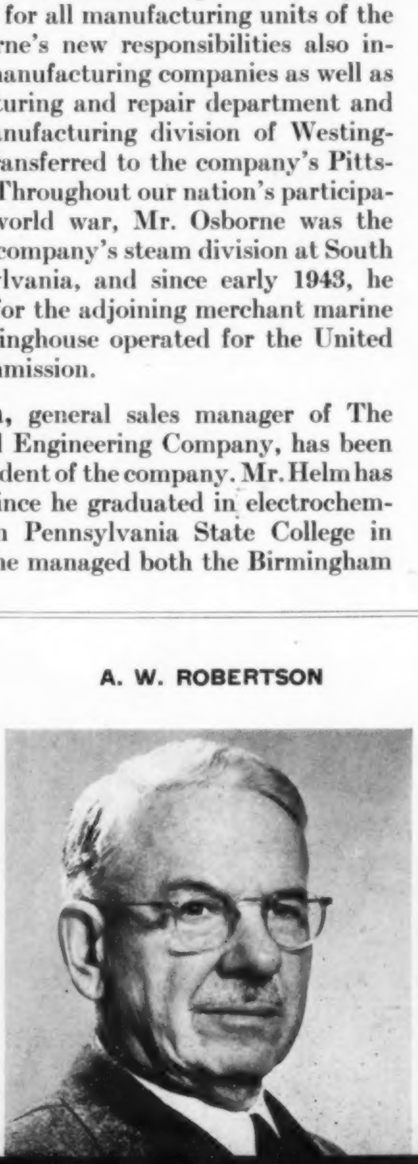
**Julius E. Graf,** also assistant chief engineer, will retain the same position upon his return from Germany where he is serving as chief engineer of the metallurgical branch of the economics division of the U. S. Control Commission.

**Dr. D. S. Eppelshimer** has recently been appointed sales manager and chief physical metallurgist of Metal Hydrides, Inc., Beverly, Massachusetts.

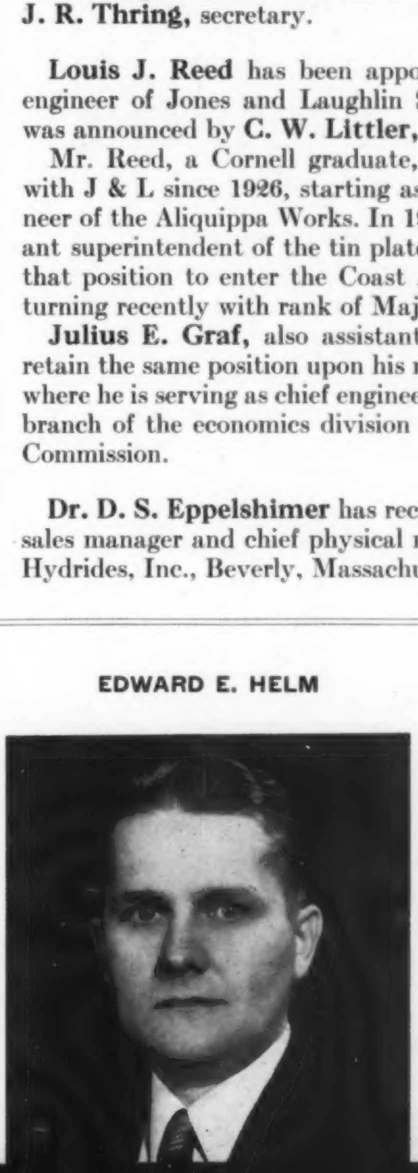
GWILYM A. PRICE



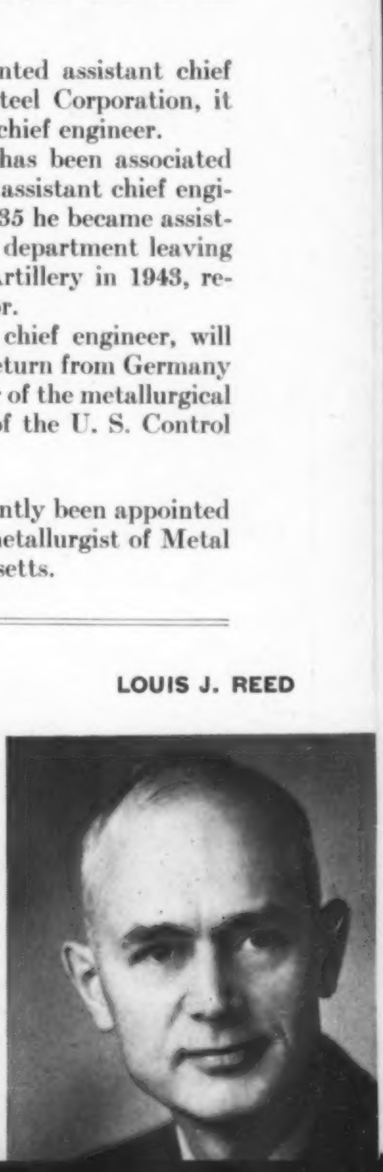
A. W. ROBERTSON



EDWARD E. HELM

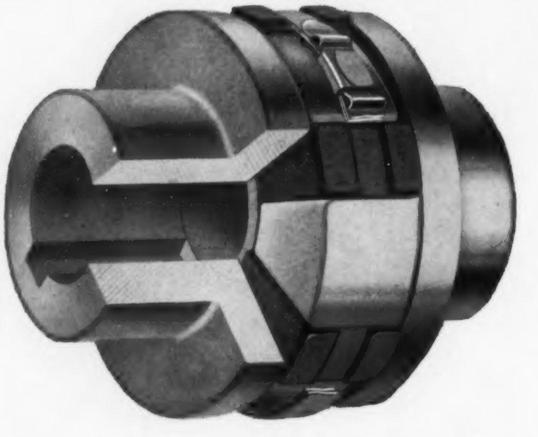


LOUIS J. REED



L-R

FLEXIBLE COUPLINGS



Lovejoy L-R Type "W" for duties from 2 to 2500 h.p.

. . . need no pampering

Rugged L-R Flexible Couplings require minimum attention. Load cushions always in sight for inspection. No lubrication required. Exceptionally quiet.

Various cushion materials provide for heavy shock loads — sustained loads — high resilience — or any speed under fluctuations of load. Load cushions can be easily and quickly interchanged without tearing down coupling.

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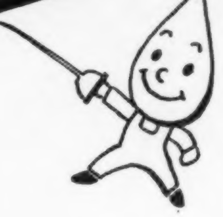
IN U.S. PAT. OFFICE & FOREIGN COUNTRIES

Provides positive pressure lubrication



If you use an efficient lubricant, pressure application systems insure dependable lubrication that keeps machines in steady service.

NON-FLUID OIL meets every requirement of pressure lubrication because it contains nothing of a residual nature that would clog fittings and allow bearings to run dry.

NON-FLUID OIL lasts longer than ordinary greases and reduces lubricant and application costs. Strictly neutral, NON-FLUID OIL is recommended by all leading makers of ball and roller bearings.

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A. G. VIOLA

J. L. PASHER

CHARLES R. NEWPHER

FRANK A. YUSEK

**A. G. Viola** has been appointed branch manager of the Kansas City branch office territory of the Wagner Electric Corporation which territory is now limited to Kansas and Nebraska and the western halves of Iowa and Missouri. Mr. Viola was transferred from the Pittsburgh territory where he was branch manager since 1939. **J. L. Pasher,** for many years manager of the Pittsburgh automotive division branch territory, is now in charge of both the electrical and automotive divisions there.

**H. W. Hartman** has been named works superintendent of the American Works of the American Steel and Wire Company. Mr. Hartman's former position of works superintendent at Newburgh Wire Works will be filled by **J. E. Brown.**

Both of these men began their employment with the Wire Company as weighers at Newburgh Wire Works. Mr. Hartman became works superintendent at Newburgh Wire Works in February, 1945, and relinquishes this position to move to American Works as superintendent.

Mr. Brown was first employed at the Newburgh Wire Works of the Wire Company in 1930. He held various positions at that mill and became general foreman in 1937. In 1942, he became general foreman of bundling and inspecting at Cuyahoga Works and was transferred in 1944 to the city office of the company as assistant chairman of the wire and finishing committee in the industrial engineering department, which position he now leaves to become works superintendent at Newburgh Wire Works.

**Edwin O. Kumler** was appointed assistant director of industrial relations of the American Steel and Wire Company, United States Steel Corporation subsidiary.

Mr. Kumler succeeds **Homer J. Weeks** who retired from that position recently after more than 40 years of service with the company. In his new capacity Mr. Kumler will direct the safety casualty and pensions sections of the company's industrial relations department.

**Charles R. Newpher,** until recently sales engineer in the Reliance Electric and Engineering Company's Cleveland district office, has been appointed production manager of the Ivanhoe Division. **Frank A. Yusek,** assistant superintendent, has been made factory superintendent of the same division. Both men will report directly to the general works manager.

A Clevelander by birth, Mr. Yusek has been with Reliance since 1918, starting as a clerk in the superintendent's office. Successively stockroom foreman, winding room foreman and general foreman of the company's No. 2 Plant, he has also served as assistant production manager, assistant superintendent and as production manager of the company's Ivanhoe Division. Also Cleveland-born, Mr. Newpher has been with Reliance since his graduation in mechanical engineering from Case School of Applied Science in 1937.

**John K. Hodnette** has been made manager of the Westinghouse Electric Corporation's transformer division at Sharon, Pennsylvania.

Mr. Hodnette, who has been engineering manager in that division for the past six years, assumes the duties formerly held by **H. V. Putman,** company vice president in charge of the transformer division, who died last January 16.

Outstanding among many transformer improvements for which Mr. Hodnette is responsible and for which he has been granted patents, is the completely self-protected distribution transformer which assures protection against lightning and outages, and minimizes service interruptions.

**William D. Todd** has recently been made assistant to the president of the Aetna-Standard Engineering Company, Youngstown, Ohio. During the war, Mr. Todd was a member of the Harriman Mission in London and later director of the steel division of the War Production Board in Washington.

**W. C. Swalley** has been elected vice president of The Wellman Engineering Company, Cleveland 4, Ohio, in charge of sales. Mr. Swalley is widely known throughout the steel and heavy industry. **A. J. Lichtinger,** a vice president of The Wellman Engineering Company, was elected a member of the board of directors.

**William G. Miller** was made manager of the headquarters manufacturing staff at Pittsburgh, Pennsylvania. In the new post, created to effect a closer coordination in the management service given the operating divisions, Mr. Miller will be responsible for the headquarters manufacturing activities of the equipment, manufacturing engineering, production, quality control and wage incentives departments.

**Robert W. Kress** of the special chemicals division, Pennsylvania Salt Manufacturing Company, has been promoted from assistant to **Joseph W. Manz,** senior sales serviceman in Chicago, to senior sales serviceman of the northern Ohio area. He will make his headquarters in Cleveland.

it's a Quick-As-Wink
THE HIGHER THE PRESSURE
AIR
WATER
OIL
THE TIGHTER THE SEAL

**Quick-As-Wink**

HUNT CONTROL VALVES

## Split-Second Control of Two Cylinders with One Valve . . .

*Here's an example of positive control.*

One Quick-As-Wink valve controls double acting cylinders. One cylinder always leads the other on the work stroke and lags the other cylinder on the return stroke.

Stainless steel body and plunger eliminate corrosion and U-packers seal valve against costly air leaks. All Quick-As-Wink valves are designed for simplicity of operation, speed, accuracy and long life.

Available in many different actions, all standard and many special sizes. Complete information in the C. B. Hunt engineering catalog, *available upon request.*

**This Tube Beading and Flaring Machine is a product of the Vaill Engineering Co., Waterbury, Conn. To bead or flare, the operator simply inserts the end of the tubing into the machine, depresses and raises the hand lever and then withdraws the finished work. The time consumed is less than it takes to describe the operation.**

**C. B. HUNT & SON, Inc. SALEM, OHIO**

M. T. MAGUIRE

**M. T. Maguire,** formerly sales manager of the coupling department of Bartlett Hayward Division, Koppers Company, is establishing a manufacturers' agency in the Pittsburgh district, Room 418, Investment building. Mr. Maguire applied the first fast coupling to a rolling mill drive in 1921.

**R. W. Moffett** has resigned as president of By-Products Steel Corporation to become general manager, fabrication, of Lukens Steel Company (Lukens, By-Products, Lukenweld) and **C. L. Huston, Jr.** has resigned as president of Lukenweld, Inc. to become executive assistant to the president of Lukens Steel Company. **Robert W. Wolcott,** president of Lukens, also has been elected president as well as chairman of the board of both By-Products and Lukenweld. **Lester M. Curtiss,** who has been general superintendent of Lukens, has been appointed general manager, steel plants (open hearth, plate mills, and supporting shops) of Lukens Steel Company.

In their new positions, both Mr. Moffet and Mr. Curtiss will report to **G. D. Spackman,** vice president in charge of operations of Lukens Steel Company.

**C. L. Huston, Jr.** will devote his major attention to developing plans for the future of the three companies. He will have his headquarters in the executive offices of Lukens Steel Company.

**L. A. Beeghly** was named chairman of the board, **W. B. Lockwood,** president and **C. M. Beeghly,** vice president, of the Cold Metal Products Company, Youngstown, Ohio, manufacturers of precision cold rolled strip steel, at an election of officers held recently.

**William Van C. Brandt** resumed his former position recently as manager of Exide motive power sales for The Electric Storage Battery Company, Philadelphia after serving in the Navy during the war.

Mr. Brandt is an old Navy man, as well as an old Exide man. He attended the U. S. Naval Academy, and served during the first World War in transport service. He re-entered the U. S. Navy during the early part of 1942 with the rank of lieutenant-commander.

HECTOR A. LOPEZ

**Hector A. Lopez** has been appointed assistant district sales manager in Pittsburgh for the Babcock-Wilcox Company. Mr. Lopez is a graduate of the Massachusetts Institute of Technology and prior to 1936, when he joined The Babcock-Wilcox Company, he was district sales representative of the B. F. Sturtevant Company in the Pittsburgh area.

**R. Gordon Anderson** is now associated with The Tool Steel Gear and Pinion Company as representative in the Pittsburgh district. Prior to March first, Mr. Anderson was connected with the Milwaukee, Wisconsin office.

R. GORDON ANDERSON

*the Complete answer*

**to your**

**TUYERE**

**requirements...**

*Quality and Delivery*

**Falcon quality, in standard or special tuyeres, never varies because:**

1. **Only virgin ingot copper is used.**
2. **Foundry technique, based on years of experience, assures uniform wall thicknesses.**
3. **Vertical casting, nose down, insures the densest metal at the nose where it is needed.**

**As zealously guarded as our reputation for quality, is Falcon's ability to make prompt delivery. This complete answer to your needs for tuyeres—or nonferrous castings—is as near as your telephone.**

TELEPHONE COLLECT—34355

**FALCON BRONZE CO.**

Established 1890 YOUNGSTOWN 3, OHIO Incorporated 1895

CROWDED?
Install an
IMO

**IMO pump circulating governor oil and lubricating oil for large turbine.**

**The IMO PUMP requires less space than most other pumps because of the high capacity attainable by its efficient, compact design and high speed operation. If desired, it can be directly connected to, and mounted upon, turbines, motors, engines, or other equipment. In special designs, dimensions and proportions can be varied to meet space limitations.** I-128

***For further information write for Catalog I-128-I.***

IMO

PUMP DIVISION OF THE
DE LAVAL STEAM TURBINE CO.
TRENTON 2, NEW JERSEY

CARROLL D. HEPLER

**Carroll D. Hepler** has been made vice president in charge of manufacturing of the Trumbull Electric Manufacturing Company, with headquarters at Plainville, Connecticut.

Mr. Hepler was recently transferred to the east from San Francisco. He joined the Trumbull organization in 1928 at the time of purchase by Trumbull of the A. G. Manufacturing Company of Seattle, Washington and Los Angeles, California. Mr. Hepler was appointed president of the Pacific division of the Trumbull Company on January 1, 1945, moving from Seattle to new headquarters at San Francisco. He will continue to serve as president of the Pacific division in addition to his new duties.

**G. B. Evans,** general superintendent since 1921 of the Wagner Electric Corporation has been promoted to plant manager. Mr. Evans has been with the Wagner Company for 41 years, having begun his career at Wagner in 1904 as a tool and die maker at the original Wagner plant located at 2017 Locust Street. In the succeeding years he gained firsthand knowledge of the functions of various departments throughout the factory, and in 1914 was made divisional superintendent. In 1921 he was promoted to general superintendent, the position he held until being made plant manager on February 1, 1946.

**C. W. Hesse** succeeds Mr. Evans as general superintendent. Mr. Hesse was plant engineer of Wagner Electric for 15 years, from 1927 until 1942, at which time he became assistant general superintendent, the position he held until his recent promotion to general superintendent.

**W. A. Okenfuss** has been promoted to assistant general superintendent. He began his employment with the Wagner Company in 1919 as an inspector in the ignition department. He handled a number of jobs throughout the shop before transferring to the time study department in 1922. He was promoted to the head of time study and operating department in 1927.

**A. J. Kerr,** formerly general sales manager, has been elected vice president of sales of the Rockwell Manufacturing Company, Pittsburgh. Mr. Kerr has been asso-

GLENN McDOWELL

ciated with the company for more than 20 years. His early career was as district manager, Tulsa office of the Pittsburgh Equitable Meter and Nordstrom Valve Companies, now divisions of the Rockwell Manufacturing Company. In 1944 he was made general sales manager.

**Glenn McDowell** has been appointed manager of roll sales for The Aetna-Standard Engineering Company, Youngstown, Ohio. During the war he has been assistant to the vice president with the specific assignment of coordinating production and expediting. Mr. McDowell has been associated with the company since 1925 in the engineering, estimating and roll sales departments.

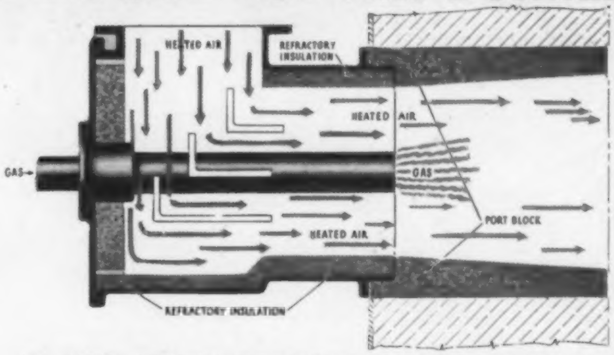
**J. H. Owen** has recently been appointed assistant district sales manager of the Chicago district of the Harbison-Walker Refractories Company. Other appointments announced by the company are **H. S. Schweinsberg** who was appointed assistant district sales manager of the Philadelphia district; **E. M. Sarraf,** who was appointed assistant district sales manager of the Cleveland district and **E. S. Stockslager,** who was appointed assistant district sales manager of the New York district.

**W. G. Winslow** has been appointed South American sales representative for the products of four leading American manufacturers. Mr. Winslow will handle sales of the Falk Corporation's speed reducers and flexible couplings, the Monitor Controller Company's electric motor controls, The Reliance Electric and Engineering Company's motors and generators and the Union Chain and Manufacturing Company's chains and sprockets.

From his headquarters in Sao Paulo, Brazil, Winslow will establish distributors in several industrial centers of the principal South American equipment markets. He acquired his first experience with South American industries as a representative of the export-import firm of W. R. Grace and Company, New York. In 1941 he joined The Reliance Electric and Engineering Company and has served as a sales engineer in the company's New York territory since 1942.

(*Please turn to page 136*)

BLOOM HOT AIR BURNER



● FOR HIGH TEMPERATURE FURNACES

The Bloom Hot Air Burner is for use with natural gas, coke oven gas, oil, tar or mixed gas, with combustion air at 600°F to 1500°F. It provides the highly efficient luminous flame, characteristic of all Bloom Long Flame Burners. Applications include soaking pits, billet heating furnaces, forge furnaces, melting furnaces, and other high temperature service.

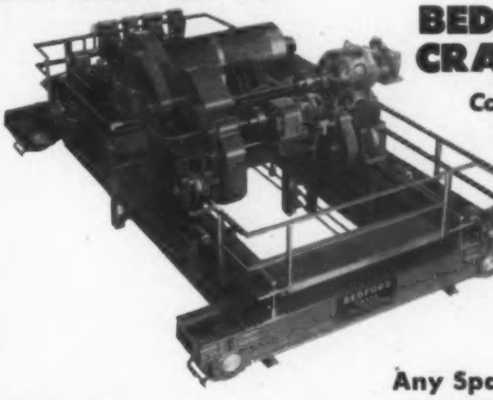
*Write for complete information.*

BLOOM ENGINEERING CO.
857 W. North Avenue Pittsburgh 12, Pa.

CRANE BUILDERS Since 1903

BEDFORD CRANES

Capacities 5 to 150 Tons



Designed and Engineered to Meet Your Requirements

Any Span or Lift
Send For Your Copy Of Catalog

ELECTRIC OVERHEAD TRAVELING CRANES
GANTRY CRANES • STEEL DERRICKS
BUILT TO YOUR SPECIFICATIONS
STRUCTURAL STEEL • STEEL BUILDINGS
AIRPLANE HANGERS

BEDFORD FOUNDRY & MACHINE CO.

Engineers
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BEDFORD, INDIANA
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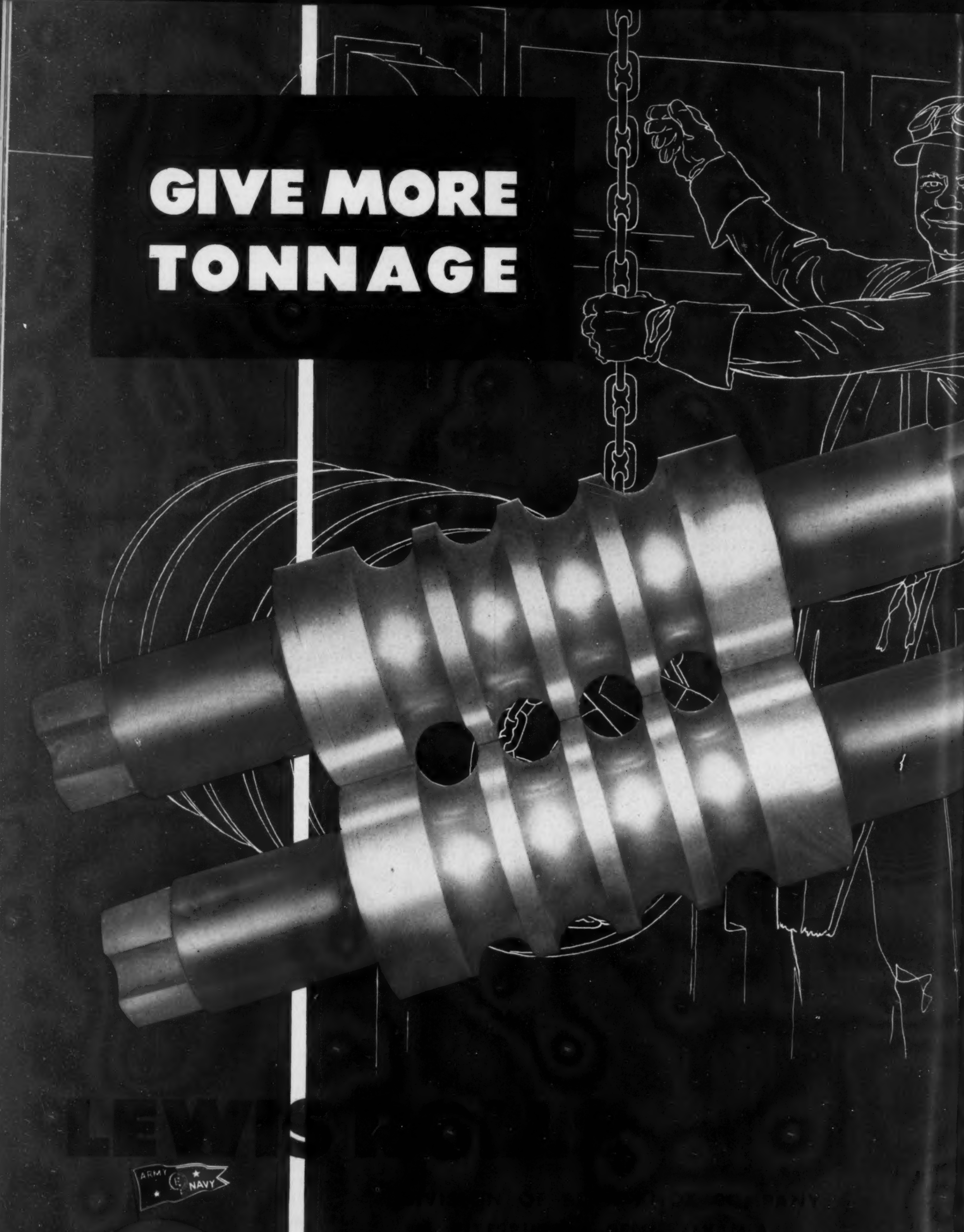
Gray
Iron
Castings

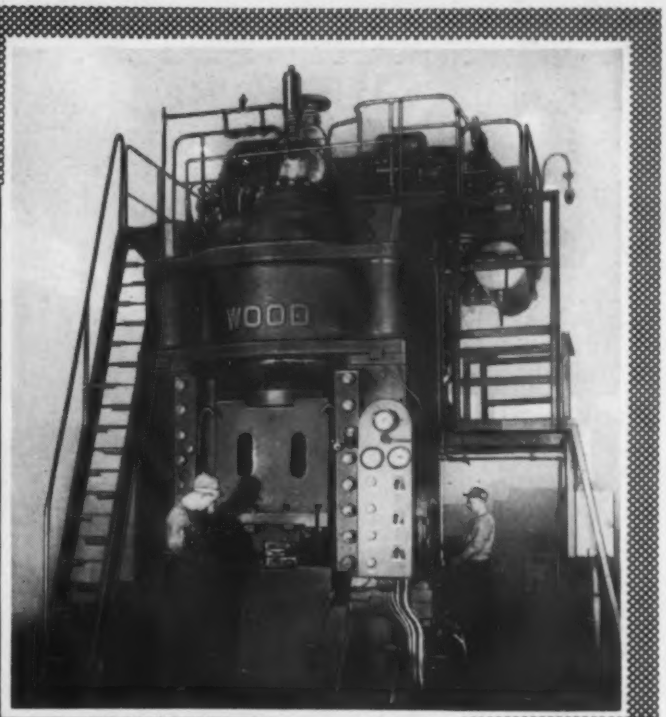

GIVE MORE TONNAGE
LEWIS [illegible]
ARMY E NAVY
Also manufacturers of
ROLLING MILL MACHINERY
for the iron, steel and
non-ferrous industries
[illegible] COMPANY
[illegible]

How... BROOKS

LEADOLENE

THE MODERN "I.P."* LUBRICANT

CUTS MAINTENANCE COSTS ON HYDRAULIC SYSTEMS



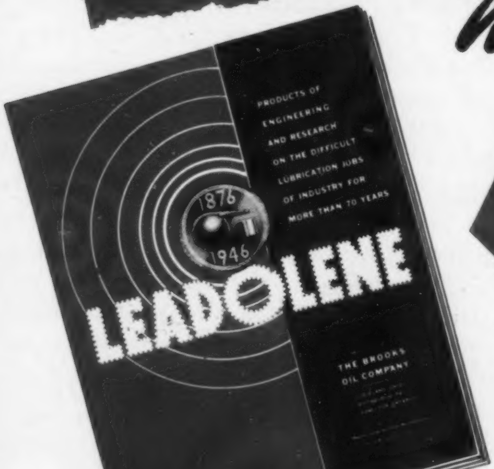
Look to Brooks "I.P."* (Indestructible pH-ilm) Leadolene for the satisfactory answer—when uninterrupted production is of paramount importance—where delays and high costs for replacement of worn parts is a major factor. Leadolene, a product of high film strength and Indestructible pH-ilm can be used in much lower viscosity—where ordinary hydraulic oils of high viscosity have previously been used. The extremely low pour point of Leadolene assures free operation with minimum power demands—even in sub zero weather.

Here is an excellent example of how "I.P."* Leadolene solved a difficult problem on three heat-treating furnaces:

Each furnace was using operating valves, sliding vane pumps, four hydraulic plungers with two cup leathers each and operating at 1000 lb. per sq. in. pressure at 100°F—for intermittent operation of pumps and plungers—were replacing every eight minutes—were replacing leathers in one to three weeks. After careful study, Brooks engineers specified "I.P."* Leadolene with the result that the service record for cup leathers is now SIX MONTHS, valve and pump service is greatly extended.

* Indestructible pH-ilm

Write for Your Copy of this Bulletin


PRODUCTS OF ENGINEERING AND RESEARCH ON THE DIFFICULT LUBRICATION JOBS OF INDUSTRY FOR MORE THAN 70 YEARS
1876
1946
LEADOLENE
THE BROOKS OIL COMPANY

Learn how the ★ High Film Strength ★ Adhesiveness ★ Non-Corrosive ★ Water Repellent ★ Stability ★ Low Temperature Factors found in "I.P."* Leadolene have cut maintenance costs in plants just like yours.

The Brooks Oil Co.

Pittsburgh 19, Pennsylvania
Cleveland, Ohio
Hamilton, Ontario

Warehouses: In Principal Industrial Cities

CAPT. R. E. JONES

**Capt. R. E. Jones,** USNR, has been appointed assistant general manager of the Blaw-Knox division of the Blaw-Knox Company.

Captain Jones is a graduate of the United States Naval Academy. After serving in the Navy in various capacities, he resigned from active duty in 1919 to enter industry in the field of engineering and plant management.

In May, 1941, before the American entry into World War II, Captain Jones was recalled to active duty to assist in putting into operation the Navy production war plans under the direction of the under secretary of the Navy.

PEERLESS PUMPS

UPON THE STRONG,
GREATER STRENGTH IS BESTOWED

A Statement by
FOOD MACHINERY
CORPORATION
in regard to
*Dayton-Dowd*

An important advance in the history of the pumping industry now for the first time makes available a new conception of integrated pump service to customers. *Dayton-Dowd,* long associated with sustained high quality—a distinguished name on centrifugal pumps—has become an integral part of the *Peerless Pump* organization.

*This merger of broad installation-wise experience, modern technical research and alert engineering talent assures our customers for both Horizontal and Vertical types of pumps that the name "Peerless" stands as the guarantee for quality and progress.*

PEERLESS
HORIZONTAL PUMPS
*-formerly Dayton-Dowd*

PEERLESS PUMP DIV.—FOOD MACHINERY CORP.
Factories: Los Angeles, Calif., Quincy, Ill., Canton, O.

F.M.C. builds with STEEL

WAR-TIME BUILDERS OF THE VICTORIOUS "WATER BUFFALO"
PEACE-TIME BUILDERS OF TOP-FLIGHT WATER PUMPS

**Carl E. Nagel's** appointment as manager of editorial service has been announced by **Charles A. Scarlott,** manager of engineering publications of the Westinghouse Electric Corporation, Pittsburgh, Pennsylvania.

Mr. Nagel, a recently discharged veteran of World War II, will be responsible for the Company's technical and trade magazine articles.

**O. P. Donohue** has been promoted to the sales promotion staff of the Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin. He will specialize in the heating, ventilating and air-conditioning industries. Prior to his service in the Navy, Mr. Donohue joined Allis-Chalmers in 1941 and has served in the company's product departments, engaged principally in serving the heating and ventilating fields.

## *Obituaries*

DR. M. J. BRADLEY

**Dr. Manson James Bradley** who was taken ill about two months ago, died on February 7th, at Philadelphia, Pennsylvania. He graduated from McMaster College in Toronto in 1914, and received his Ph.D. from the University of Illinois in 1921.

Dr. Bradley was associated with the firm of Leeds and Northrup Company for the past eighteen years. Prior to that time he had taught at the University of Illinois and at the University of Cincinnati where he had been an assistant professor of chemical engineering. He was a frequent contributor to the Iron and Steel Engineer and a regular attendant at Association meetings.

**J. Milton Hughes,** general purchasing agent of the Sharon Steel Corporation died Wednesday, February 13, 1946. Mr. Hughes at the time of his death had been with Sharon Steel Corporation for forty-five years.

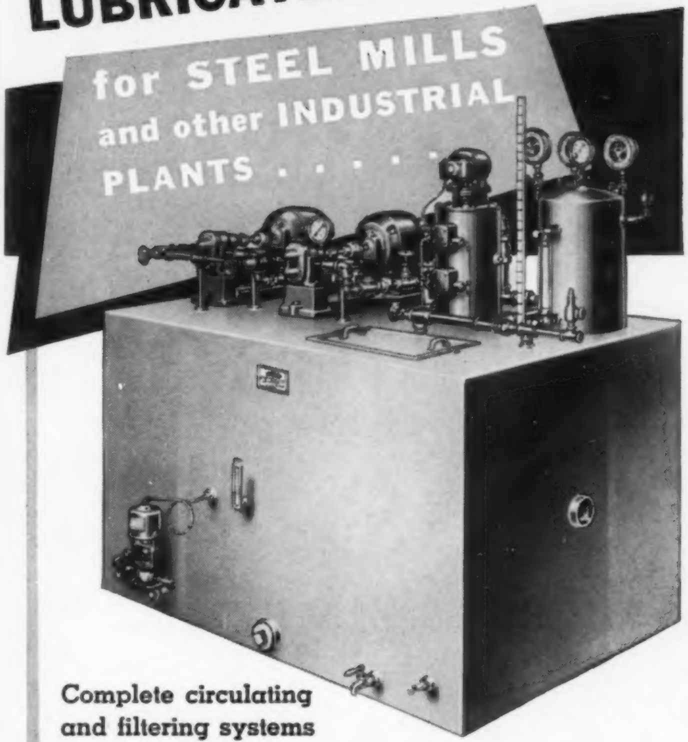
**Peer D. Nielsen,** 42, vice president in charge of operations at the Kaiser steel plant at Fontana, died February 28th, of injuries received in an auto accident February 24th.

Mr. Nielsen, former superintendent of the Geneva steel plant at Provo, Utah, died in the hospital, where he was taken when his car collided with a bus.

**BOWSER**
ESTABLISHED 1885

## LUBRICATING SYSTEMS

for STEEL MILLS
and other INDUSTRIAL
PLANTS . . . . .



Complete circulating
and filtering systems

**A PRIME FACTOR IN *LOWERING* PLANT MAINTENANCE COSTS**

**Bowser lubricating equipment is designed to meet the operating requirements of practically any plant by combining standard Bowser filters, conditioners, lubricators, pumps, storage tanks and automatic controls into a complete system.**

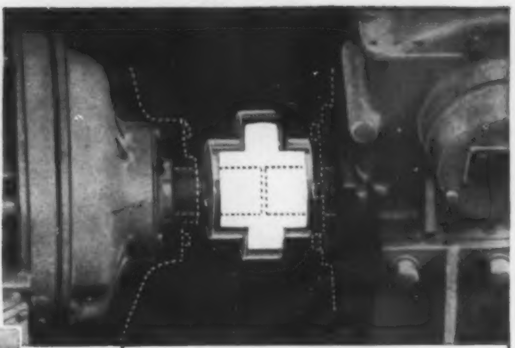
**Self-contained units with filter, circulating pumps, pressure tank and controls are available in a wide range of capacities.**

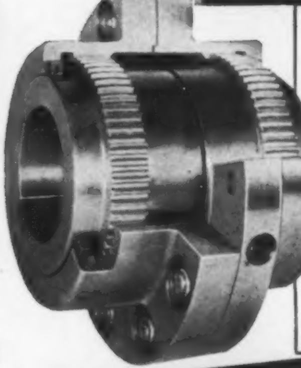
**Consult a Bowser Lubrication Engineer about your lubrication problems now. Write Bowser, Inc., 1314 Creighton Avenue, Fort Wayne 2, Indiana**

**LIQUID CONTROL SPECIALISTS SINCE 1885**

PRESSURE FILTER
FORCE FEED LUBRICATOR
OIL CONDITIONER

*Coupling Users!*





**SAVE**
**COST · SPACE**
*and*
**SHAFT**
**EXTENSION**

**WALDRON** NEW Series "A" **COUPLING**
permits use of smaller sizes by
providing larger maximum bore

Waldron leads again . . . with a new design development that means greater accuracy and economies for coupling users. The new "Series A" Waldron Gear Type Coupling is designed to reduce size of coupling required for the particular shaft, reduce shaft extension for greater accuracy in operation, save space—and money.

It embodies all the famous Waldron design refinements: all forged steel, made to close manufacturing tolerances with positive dust proof and oil tight seal. Identical externally geared hubs key to shafts, enclosed by two piece cover sleeve that functions as a single rigid unit.

**Ask us to send you specific advanced information on this new "Series A" Waldron Coupling that will easily prove most accurate and economical to buy and use.**

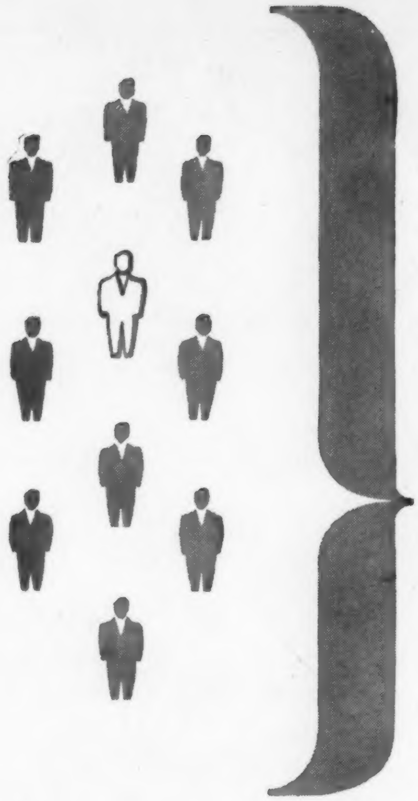
**Made in Standard, Mill Motor, Heavy Duty, Floating Shaft, Cut-Out, Sheer Pin, Spacer Sleeve, Jordan, Vertical Floating Shaft and Rigid Types.**

COUPLING DIVISION

**JOHN WALDRON CORP.**

Main Office and Works
**New Brunswick,**
**New Jersey**

**COUPLINGS**



# 9 OUT OF 10 *want* THE PAYROLL SAVINGS PLAN CONTINUED!

Thanks to the cooperation and encouragement of America's industrial executives, 85 million bond holders have bought U.S. Bonds in the greatest savings program in history. Employees who have purchased billions of dollars of these bonds during the war now want to continue monthly purchases of savings bonds. Specific evidence of this desire to continue saving for personal security and prosperity through the Payroll Savings Plan was recently revealed by a survey which disclosed that 90% wanted the Plan continued.

Every employer can write in his own set of reasons why the Payroll Savings Plan should be continued as a part of his personnel relations program, but the principal advantages are obvious:

***A large reservoir of national savings; a strong and stable bulwark against inflation.***

***An "automatic" thrift habit for the worker; to increase contentment and satisfaction in his job.***

***An opportunity for the employee to maintain his "share in America" with the safest, easiest, most profitable investment he can make.***

***An opportunity for the returned veteran to share in the Payroll Plan's varied benefits.***

**Your employees will require little "selling" on the idea—they are accustomed to their monthly saving habit. With the Treasury Department's savings bond program now in peacetime operation, your partnership is again invited to continue this systematic, convenient means of contribution to a prosperous peacetime future.**

*The Treasury Department acknowledges with appreciation the publication of this message by*

## IRON AND STEEL ENGINEER

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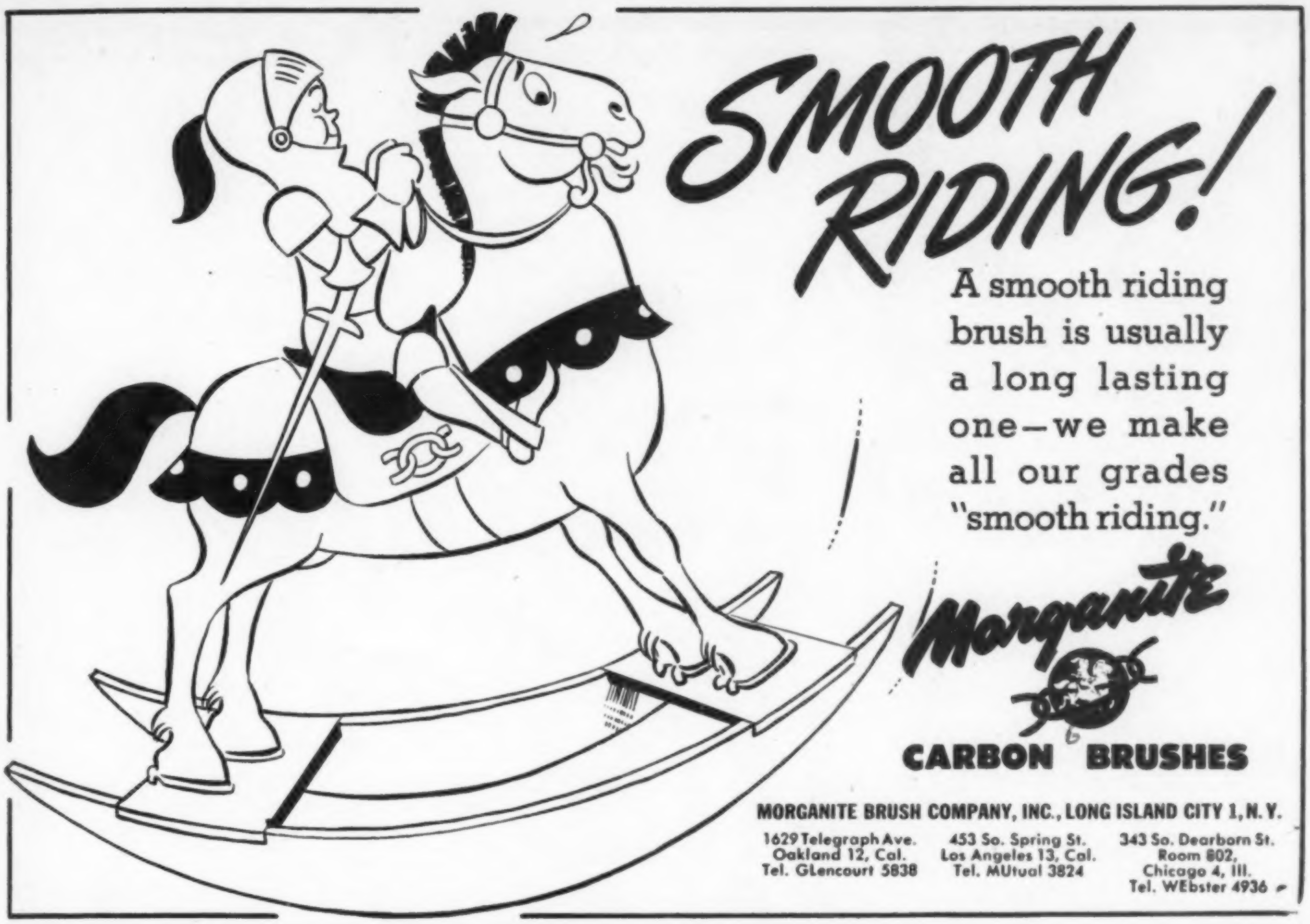

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A smooth riding brush is usually a long lasting one—we make all our grades "smooth riding."

Morganite

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**Monday and Tuesday, May 6 - 7**

**CONGRESS HOTEL** **CHICAGO, ILLINOIS**

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**J. J. Beese**
*Assistant Manager — Hot Strip Mills*
Richard Thomas and Baldwins, Ltd.
Ebbw. Vale., Mon., Great Britain

**Robert S. Burns**
*Associate Director — Research Laboratories*
American Rolling Mill Company
Middletown, Ohio

**Chuan Chang**
*Engineer*
Kaiser Company, Inc.
Fontana, California

**Elmer F. Dietrich**
*Steel Mill Superintendent's Office*
*Special Assignment*
Ford Motor Company
Dearborn, Michigan

**Thurman L. Dollar**
*Temper Mill Turn Foreman*
Tennessee Coal, Iron and Railroad Company
Fairfield, Alabama

**Charles Durnian**
*General Shift Foreman (Rail Mill)*
Ford Motor Company
Dearborn, Michigan

**L. V. Ennis**
*General Foreman, Merchant Mill Finish*
Great Lakes Steel Corporation
Ecorse, Detroit, Michigan

**Ralph F. Fien**
*General Foreman*
Ford Motor Company
Dearborn, Michigan

**Irvin J. Gribble**
*General Shift Foreman (Soaking Pits)*
Ford Motor Company
Dearborn, Michigan

**Wm. T. Hartman**
*Supervisor of Millwrights*
Lukens Steel Company
Coatesville, Pennsylvania

**Wang Hsien**
*General Metallurgist*
Tze-Yu Iron and Steel Works
National Resources Commission
Chungking, China

**Herbert L. Klinker**
*General Foreman*
B. B. and S. Electrical Department
Great Lakes Steel Corporation
Ecorse, Detroit, Michigan

**Alfred Krause**
*Superintendent Open Hearth*
Ford Motor Company
Dearborn, Michigan

**Yung Tsuen Liu**
*Senior Engineer — Steel Making Works*
China Industrial Company
Chungking, China

**A. I. Lubnin**
*Engineer*
Department of Heavy Industrial Equipment
Government Purchasing Commission of Soviet
Union in U. S. A.
Washington, District of Columbia

**Nathaniel Martin**
*General Manager — Midland Branch*
Richard Thomas and Baldwins, Limited
London, England

**R. W. Matuschek**
*Personnel Director*
Rotary Electric Steel Company
Detroit, Michigan

**N. I. Naryshkin**
*Assistant Chief*
Department Heavy Industrial Equipment
Government Purchasing Commission of Soviet
Union in U. S. A.
Washington, District of Columbia

**J. Marshall Orris**
*Superintendent Mills*
Columbia Steel Company
Torrance, California

**Edward H. Patrick**
*Assistant Superintendent of Open Hearth*
Ford Motor Company
Dearborn, Michigan

**Edmund L. Patten**
*Electrical Engineer*
Great Lakes Steel Corporation
Ecorse, Detroit, Michigan

**E. Pinches**
*Chief Designer — Iron and Steel Works Plant*
Messrs. Dorman Long and Company, Limited
Middlesbrough, Yorkshire, England

**Francis Queen**
*Combustion Engineer*
Ford Motor Company
Dearborn, Michigan

**Frederick Robson**
*General Roll Shop Foreman*
Tennessee Coal, Iron and Railroad Company
Fairfield, Alabama

**Edward C. Roehll**
*Chief Metallurgist*
Altos Hornos de Mexico, S. A.
Monclova, Coahuila, Mexico

**A. M. Rybalchenko**
*Engineer*
Department of Heavy Industrial Equipment
Government Purchasing Commission of Soviet
Union in U. S. A.
Washington, District of Columbia

**Edward H. Romanelli**
*Roller*
Ford Motor Company
Dearborn, Michigan

**George J. Scherba**
*Design Engineer — Squad Leader*
Carnegie-Illinois Steel Corporation
Munhall, Pennsylvania

**R. P. Schuler**
*Roller — 44 Inch Hot Strip Mill*
Inland Steel Company
East Chicago, Indiana

**R. G. Sellers**
*Assistant Open Hearth Superintendent*
Ford Motor Company
Dearborn, Michigan

**John A. Shaffer**
*Electrical Designer*
Engineering Department
Jones and Laughlin Steel Corporation
Pittsburgh, Pennsylvania

**C. E. Siegelin**
*General Foreman — Electrical Department*
Wisconsin Steel Works
International Harvester Company
Chicago, Illinois

**John E. Sowers, Jr.**
*General Foreman — Electrical Department*
Bethlehem Steel Company
Lackawanna, New York

**James K. Sutherland**
*Superintendent Open Hearth and Mills*
Ford Motor Company
Dearborn, Michigan

**D. Thomson**
*General Manager*
Richard Thomas and Baldwins, Limited
Monmouthshire, England

**N. G. Veselkov**
*Engineer*
Department of Heavy Industrial Equipment
Government Purchasing Commission of Soviet
Union in U. S. A.
Washington, District of Columbia

**John R. Watson**
*Blooming and Structural Mill Superintendent*
Bethlehem Steel Company
Lackawanna, New York

**Irvin E. Wade**
*Assistant General Foreman*
Ford Motor Company
Dearborn, Michigan

**James Crenshaw Walker**
*Assistant General Foreman*
Ford Motor Company
Dearborn, Michigan

**William Wargo**
*Engineer*
Ford Motor Company
Dearborn, Michigan

**Noah Webster**
*Assistant General Foreman — Soaking Pits*
Ford Motor Company
Dearborn, Michigan

**E. Chester White**
*Metallurgist*
Ford Motor Company
Dearborn, Michigan

**W. E. White**
*Personal Assistant to Chief Engineer*
Messrs. Dorman Long and Company, Limited
Middlesbrough, Yorkshire, England

**Elmer William Willard**
*Assistant Superintendent No. 7 Mine*
Bethlehem Steel Company
Lackawanna, New York

**Ching-sheng Yu**
China Steel Manufacturing Corporation
c/o Kaiser Company, Incorporated
Fontana, California

**George F. Zuehlke**
*Assistant General Foreman*
Ford Motor Company
Dearborn, Michigan

**Maurice D. Ayres**
*Chief Engineer*
Steel Company of Canada, Ltd.
Hamilton, Ontario, Canada

**Edward D. Badgett**
*Chief Electrician*
Granite City Steel Company
Granite City, Illinois

**Wayne H. Beall**
*Designer — Engineering Department*
Great Lakes Steel Corporation
Ecorse, Detroit, Michigan

**W. R. Beasley**
*Assistant Chief Design Engineer*
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Munhall, Pennsylvania

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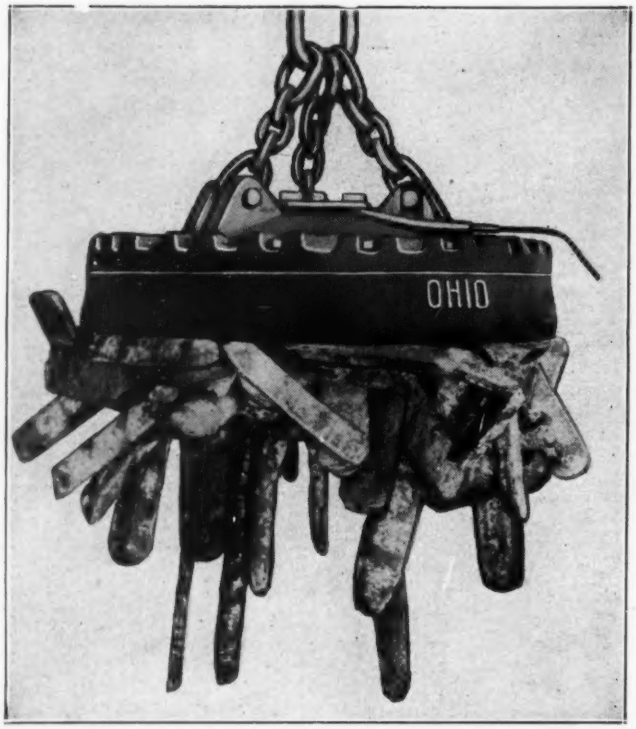

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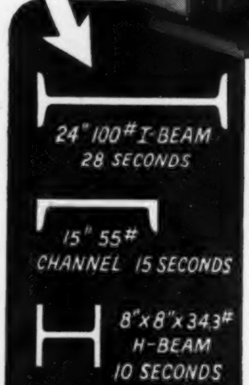
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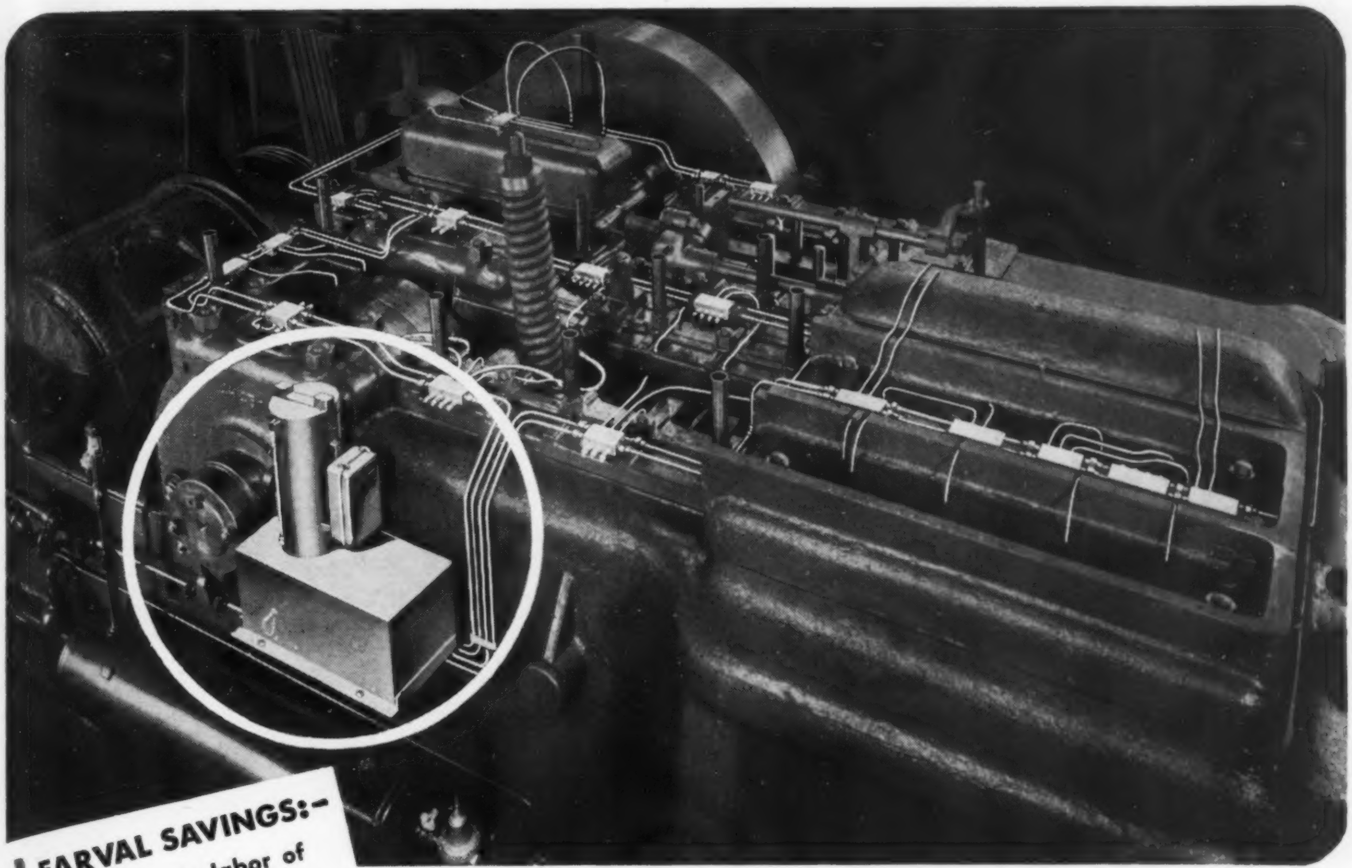

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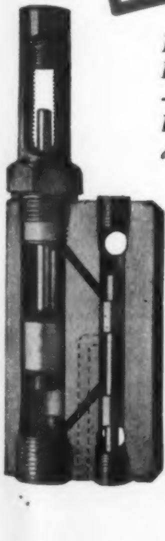

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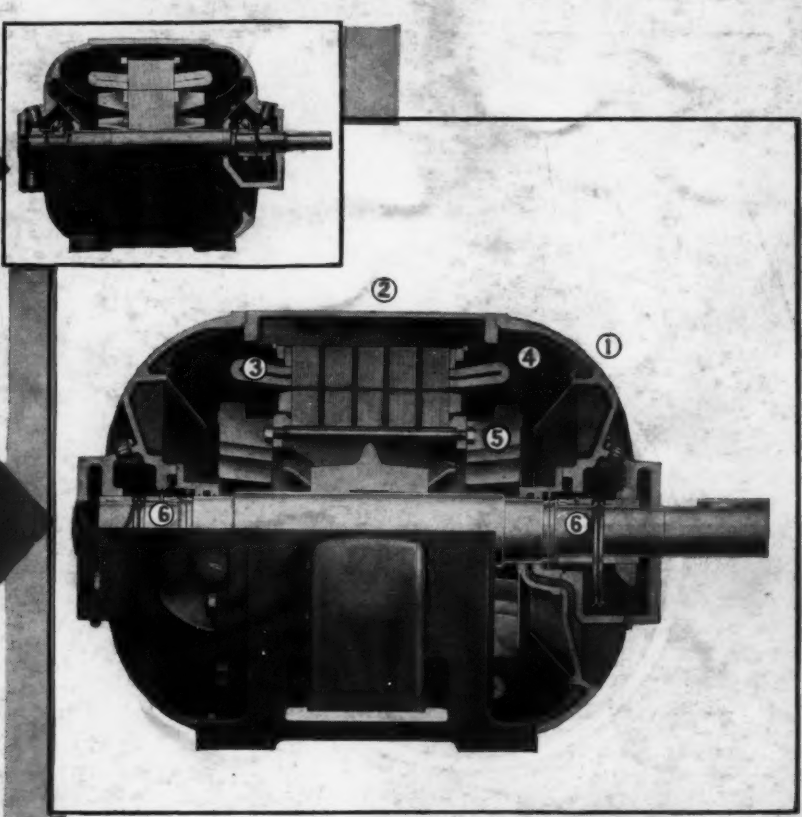

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